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THE CONVERSION OF THE ENERGY OF CARBON.

A description of the experiments performed by Mr. Reed on the Jacques carbon battery, an abstract of which was published in these columns June 6, will be found in detail elsewhere in this issue. It is difficult to account for the very high E. M. F. which this type of battery produces on the assumption that its action is thermo-electric, and yet that its action is not galvanic seems to be conclusively demonstrated. The reversal of polarity at certain temperatures, the non-consumption of the electrodes, the indiscriminate action of air and coal gas, and the slight differences in the E. M. F. when different electrodes are used, lead to but one conclusion. As Mr. Reed states, the thermo-electric power between iron and alkali must be enormous compared with that of thermo-electric couples composed of any two metals. The article would be still more interesting if the author had given the results of some efficiency tests.

NORTHWESTERN ELECTRICAL ASSOCIATION CONVENTION.

An extended report of the fourth semi-annual convention of the Northwestern Electrical Association, held in Marinette, Wis., will be found in our columns of this issue. From the social standpoint the meeting was a success, but the papers read were of an inferior quality. As few of the authors presented them in person there was practically no discussion of the subjects treated. The chief feature was the critical arraignment of the methods and management of the National Electric Light Association, much of which was deserved, but more of which was ill advised. As to the papers which were presented before the annual meeting held in New York City, it is true that they were not up to the standard of excellence which an association of such standing should provide, and yet we do not doubt that the committee exerted its best influence to obtain papers which would be of the greatest value to the members. We cannot believe that those presented were too technical in their nature for the average central station man, or that his education is so limited that he must be treated with old and familiar subjects set forth in platitudinous statements. If such be the case, then the opinion expressed by Mr. Mercein that papers should not be distributed prior to the meeting, should be considered with favor. If, however, subjects are to be presented bearing upon the detail rather than the superficial problems met with in central station practice, it is reasonable to suppose that the discussions pertaining to such subjects can be the more logically and forcibly presented if they have received attention and consideration prior to the meeting at which they are brought up. Inasmuch as papers differ materially in their scope and character, perhaps the best plan would be to have all papers submitted to a committee for their decision as to when they should be published and distributed. Mr. Mercein stated quite properly that there was in evidence at the May meeting of the National Association a desire on the part of the members to ask questions tending to discomfit the author rather than for the purpose of obtaining information. The best paper presented before the Marinette Convention was on "Alternating-Current Motors," by Prof. Jackson. One of the requisites stipulated by the author determining a good alternating-current motor is a high-power factor, but if such is attained at the sacrifice of efficiency, this statement is to be received with some consideration. A high efficiency is advantageous to both the consumer and the central station manager, inasmuch as it gives to the former the

largest return for the energy consumed, and to the latter the satisfaction that the consumer is pleased. A high-power factor, however, affects only the central station output. In American practice, motors, as a rule, run continuously throughout the day, developing anywhere from the power absorbed by idle belts to about one half the rated capacity, the maximum load coming on only at infrequent intervals. It would appear therefore that a high power factor is desirable, but inasmuch as motors produce the largest proportion of the day load and as generators and engines work most efficiently at full load, it follows that unless the motor load is approximately the same as the night lighting load, the attainment of a high power factor should not be at the sacrifice of efficiency.

MAGNETIC UNITS.

In *L'Eclairage Electrique* for June 20, page 529, M. A. Blondel presents a clear, able and comprehensive article on the question of magnetic units, an abstract of which appears in our *Digest*, page 86, issue of July 18. The discussion embraces, first, the magnetic units proposed by the Sub-committee of the American Institute of Electrical Engineers "On Provisional Programme for the International Electrical Congress of 1893," published in Volume X. of the Institute Transactions. Second, the names for C. G. S. magnetic units provisionally adopted by the Institute, and which will be found in Volume XI. of the Transactions. Third, the units and names suggested by the British Association at the Ipswich meeting, in September, 1895; published in the London *Electrician* of Sept. 20, 1895, page 663. Fourth, the "rational" units suggested by Mr. Oliver Heaviside. M. Blondel gives his reasons for arriving at the conclusion that neither the system of the British Association nor the C. G. S. units adopted by the Institute should receive endorsement by an international electrical congress, but that the system most desirable is that suggested in the provisional programme of the Institute with the omission of the unit of flux density therein proposed. Although M. Blondel's article appears to us as one of the best statements of the subject that has yet been presented and which we recommend to our readers interested in this question, still from our own point of view the matter appears in a somewhat different light. It is well known that in electricity and magnetism we deal with magnitudes in two different systems of units. First, the fundamental centimetre-gramme-second or C. G. S. system, which is international, and pervades all sciences; and, second, the practical system, or quadrant-eleventhet-gramme-second (10^9 cms, 10^{-11} gms, sec.), or Q. E. S. system, based upon the C. G. S. system, and by which the ohm, volt, ampere, coulomb, joule, watt, farad, and henry are defined. This is also international. In the C. G. S. system all electromagnetic magnitudes have definite unit values, with no names internationally adopted with the exception of dine and erg. In the Q. E. S., or practical system, no magnetic units are yet internationally recognized. Early in 1893 the Institute published the report of its committee proposing a programme for the consideration of the Chicago Electrical Congress. In this programme magnetic units were suggested for adoption and christening. Their magnitudes pertained to the Q. E. S. system conformably with the other practical units, while the names suggested were the Gilbert, Weber, Oersted, and Gauss. When the Chicago Electrical Congress convened the delegates voted by a large majority against the introduction at that time of any new magnetic units, deeming that the C. G. S. system adequately provided for such units, and that names for these were unnecessary. Subsequent events have indicated that names for magnetic units are needed to a greater or less degree by those who are practically interested in electrodynamic machinery and in magnetic circuits generally, and various tentative proposals for such names have appeared at different times in electrical literature. In March, 1894, the Institute, seeing that the creation of new practical units was beyond its province and that it could not in courtesy adopt the practical units which had been rejected six months previously by the Chicago Congress, decided to bestow its suggested names upon the corresponding C. G. S. magnetic units already in existence and in universal employment and provisionally adopt those names. On our side of the Atlantic they have come into fairly extended although not universal use. In September, 1895, the British Association suggested the use of two magnetic units, one in the Q. E. S., or practical system for magnetic flux, to be called the weber, and the other in the C. G. S. or fundamental system for M. M. F. to be called the gauss. It does not seem probable that any international congress will endorse a unit whose magnitude is neither in the C. G. S. nor Q. E. S. system. To create a unit outside of these systems would be not only unprecedented, but would give rise to endless confusion both in theory and in practical application. Consequently, if the next international congress adopts any magnetic units they will probably be in either of these two systems. All units hitherto adopted by electrical congresses have been in the Q. E. S. system, and it is therefore probable that any new magnetic units would be in that system. This was the course suggested by the Institute in 1893. As to the names which should be given to such units, that is a matter of secondary importance, but it would be well that they should be new names not already introduced into the controversy. We sincerely hope that the coming congress to be convened in Geneva in August will arrive at some definite understanding upon this question which it has decided to take up. If, on the other hand, it or any other congress takes the same attitude as that at Chicago and declares against any new magnetic unit, the American Institute's C. G. S. units are not imperiled since they are permanent, but only the recognition outside this country of its provisional christenings. International agreement and concurrence of usage are to be desired above all local advantages. Whatever the international congress may decide upon will no doubt receive full and cordial American endorsement, but it is unreasonable to expect that the American Institute should at present give up its provisionally adopted complete and coherent C. G. S. system in favor of the incomplete, incoherent C. G. S.-Q. E. S. system suggested by the British Association.

The Rapid Transit Problem in New York.

On July 16 Mr. George J. Gould, in behalf of the Manhattan Elevated Railway Company, submitted to the Rapid Transit Commission an amended application to extend his company's lines. The plans were an ultimatum, and in an accompanying letter Mr. Gould stated that the proposed extensions could only be contemplated under a condition that there be no substantial claim for damages on the part of property owners along the proposed routes.

Among the most important provisions of the amended plan is one for the building of a surface overhead trolley road in place of the originally proposed extension of the elevated system in the section of Westchester County northwest of the present Ninth Avenue terminus.

But one fare is to be charged for a continuous trip over the roads, according to the plans, and proper transfers and stations are to be provided.

Mr. Gould asked that, excepting on the proposed trolley route, his company be allowed to use as motive power compressed air, electricity or steam. He said that a trolley system was devised simply as a temporary remedy through a district that was so sparsely populated that the company could not, from a pecuniary standpoint, see its way clear to operate or build an elevated structure. When the business warranted, he said, he would be only too willing to build an elevated structure, but at present it was out of the question. Mr. Gould also asked, with regard to the new elevated extensions, that provision be made for a four-track structure.

On the Measurement of the Insulation Resistance of Continuous-Current Three-Wire Systems While at Work.

BY EDWIN J. HOUSTON, PH.D. AND A. E. KENNELLY, SC.D.

A three-wire system for incandescent lighting may be

(*a*) Contained within the walls of a single building and have an insulation from ground of hundreds or thousands of ohms.

(*b*) It may extend over a large network of buried conductors in streets, and have an insulation so low as to be measurable in ohms, or decimals of an ohm.

(*c*) It may be grounded permanently at its neutral, in which case the insulation is, of course, *nil*.

It is here proposed to consider systems corresponding to classes (*a*) and (*b*), which may be considered as insulated systems, in contradistinction to systems of class (*c*), which are uninsulated systems.

Fig. 1 diagrammatically represents a three-wire system. + + is the positive conductor, — — the negative conductor, and O O the neutral conductor. Each of these conductors, although represented as a single straight line, may be considered as spreading, branching out and ramifying over a network of any degree of complexity. These feeders or mains are supplied by two E. M. Fs. of e_p volts on the positive side, and e_n volts on the negative side respectively, their sum $e_p + e_n$ being E volts. Each of the three conductors has electric leakage distributed along it in any manner. Between them are connected lamps or other translating devices. Under these conditions, the conductors will behave as though they possessed single resultant leaks of

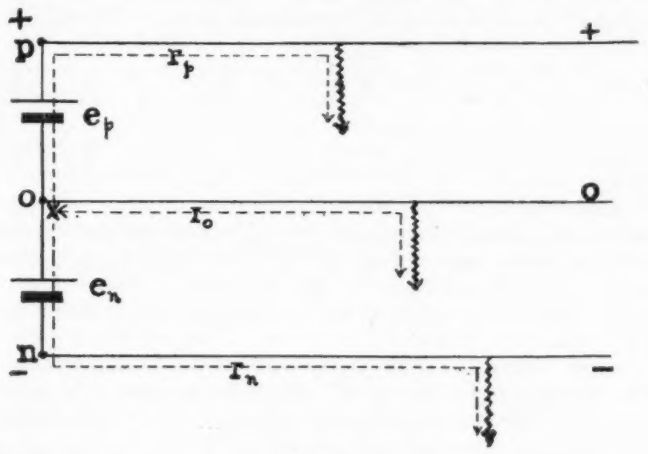


FIG 1.

r_p, r_o, and r_n ohms respectively, including the conductor resistances up to the resultants, and measured from the neutral bus-bar o, or common connection, r_p and r_n therefore, include the small resistances in the generator armatures. It may be considered that for all practical purposes these apparent insulation resistances do not depend upon the load on the system; or, in other words, that the drop of pressure in the conductors when loaded is relatively too small to affect the apparent resistances up to and included in the resultant faults. On this assumption we may safely ignore the load on the system, and consider the system as completely unloaded and as represented in Fig. 1, where the only currents which flow are leakage currents.

Let the potentials between the points p, o and n and the ground be measured and denoted by u_p, u_o and u_n respectively. If the insulation of the system were perfect, and each of the two E. M. Fs. e_p and e_n equal, the potential at o would be zero, while those at p and n would be $+ e_p$ and $- e_n$ volts respectively. The slightest dissymmetrical leakage in the system would, however, change this distribution; such, for example, as the connection of a grounded voltmeter to either p or n. In almost all practical cases, however, the influence of the leakage effected through the resistance of a high resistance voltmeter is negligible, and the potentials at p, o and n are:

$$u_p = \frac{g_o e_p + g_n E}{G} \text{ volts} \qquad (1)$$

$$u_o = u_p - e_p = \frac{g_n e_n - g_p e_p}{G} \text{ volts} \qquad (2)$$

$$u_n = u_p - e_p - e_n = u_o - e_n = -\frac{g_o e_n + g_p E}{G} \text{ volts} \qquad (3)$$

Where g_p, g_o, and $g_n = \frac{1}{r_p} \frac{1}{r_o}$ and $\frac{1}{r_n}$ mhos, respectively (4)

$$\text{also } G = g_p + g_o + g_n \text{ mhos} \qquad (5)$$

$$E = e_p + e_n \text{ volts}$$

For example, if $r_p = 100$ ohms, $g_p = \frac{1}{100} = 0.010$ mho

$r_o = 200$ ohms, $g_o = \frac{1}{200} = 0.005$ mho

$r_n = 250$ ohms, $g_n = \frac{1}{250} = 0.004$ mho

$G = 0.019$ mho

Also if $e_p = 120$ volts

$e_n = 120$ volts

$$u_p = \frac{0.005 \times 120 + 0.004\,(120 + 120)}{0.019} = 82.12 \text{ volts.}$$

$$u_o = \frac{0.004 \times 120 - 0.01 \times 120}{0.019} = -37.88 \text{ volts.}$$

$$u_n = -\frac{0.005 \times 120 + 0.01\,(120 + 120)}{0.019} = -157.88 \text{ volts.}$$

Theoretically, it is evidently only necessary to observe one potential, since the difference between any pair of the potentials is the E. M. F. between them as supplied at the generator terminals.

It is evident that when a ground occurs on one conductor, its potential becomes zero. If a ground occurs on the positive conductor, there is a tendency to the condition

$$u_p = o;\ u_o = -e_p;\ u_n = -E$$

If a ground occurs on the negative conductor, the tendency is to be the condition

$$u_p = E;\ u_o = e_n;\ u_n = o$$

and, if the ground occurs on the neutral main, the corresponding condition is

$$u_p = e_p;\ u_o = o;\ u_n = -e_n$$

Consequently, a high reading on an outside conductor indicates a ground on the opposite outside conductor; while equal and opposite potentials on the outside conductors indicate symmetrical leakage; that is to say, leakage which may be either great or small, but is either on the neutral conductor or symmetrically distributed with regard to it.

While, therefore, a voltmeter connected to one of the outside conductors of a three-wire system gives qualitative information concerning the insulation of the system, it gives but little quantitative information.

We propose to show how such quantitative information may be obtained. So far as the authors are aware, no method has been published for the determination of the three insulation resistances, r_p, r_o and r_n, during the working of the system, without the use of a Wheatstone bridge of special construction.

The first step is to find G, the joint insulation conductance of the system, by a method already known. For this purpose a leak of g mhos is connected to one of the bus-bars at the central station, say at O, Fig. 1. Then u_o falls to $u'_o = \frac{g_n e_n - g_p e_p}{G+g}$ volts (6). That is to say, the potential of the neutral bus-bar is lowered in the ratio $\frac{G}{G+g}$. The same is true if this single leak be applied successively at p and at n when

$$u'_p = \frac{g_o e_p + g_n E}{G+g};\quad \text{and } u'_n = -\frac{g_o e_n + g_p E}{G+g} \text{ volts.} \qquad (7)$$

successively and respectively. In other words, the leak g lowers the potential of the bus to which it is connected, in the ratio of $\frac{G}{G+g}$. If $g = G$, this ratio will be one half, so that if a leak be applied to one of the bus bars, and adjusted so that the potential of the bus is thereby halved, the conductance of the leak is equal to the insulation conductance of the entire system, including all three conductors. If the leak g cannot be so adjusted, we have the relation

$$G = g\left(\frac{u'}{u'_1 - u'}\right) \text{ mhos.} \qquad (8)$$

This result, or its equivalent, was first pointed out by Dr. O. Froelich in the *Electrotechnische Zeitschrift*, January, 1893.

For example, in the case last considered, suppose a conductance of $g = 0.025$ mho (40 ohms) connected to the neutral bus-bar, then by (6)

$$u'_o = \frac{0.004 \times 120 - 0.01 \times 120}{0.019 + 0.025} = -\frac{0.72}{0.044} = -16.36 \text{ volts},$$

and by (8) $G = 0.025 \left(\frac{-16.36}{-37.88 + 16.36}\right) =$

$$0.025 \times \frac{-16.36}{21.52} = 0.019 \text{ mho},$$

so that the resultant fault $\frac{I}{G}$ in the system has a resistance of $\frac{1}{0.019}$ or 52.6 ohms. This test, therefore, determines $G = g_p + g_o + g_n$. If e_p and e_n are made equal for the purposes of a brief test, we obtain one other relation between the required quantities g_p, g_o and g_n; namely, when $e_p = e_n$,

$$g_n - g_p = \frac{G}{E}(u_p + u_n) \quad \text{mhos.} \qquad (9)$$

Thus in the preceding example, since we have already assumed $e_p = e_n$

$$g_n - g_p = \frac{0.019}{240}(82.12 - 157.88)$$

$$= \frac{0.019 \times -75.76}{240} = -0.006 \text{ mho}.$$

$$\therefore g_p - g_n = 0.006 \text{ mho}.$$

It would appear that no combination of leaks applied to the system suffices to supply another independent relation between g_p, g_o and g_n, so that while equation (8) gives the aggregate or joint leakage con-

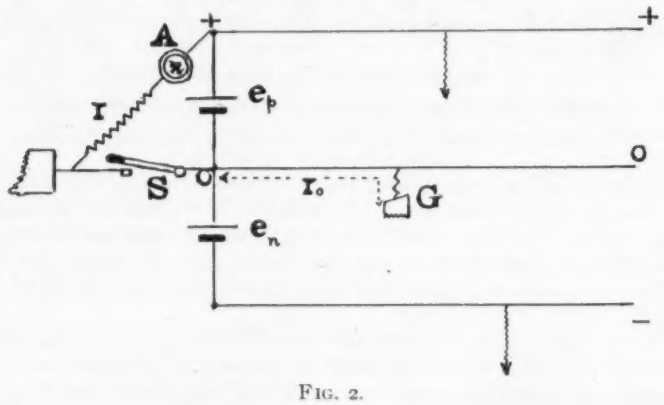


Fig. 2.

ductance of the system, one more independent equation is needed besides (9), to determine the separate conductances g_p, g_o and g_n, unless one of them is very great; *i. e.*, unless one conductor is grounded.

Referring, however, to equation (1) we find that if we alter the E. M. F. e_n by an amount $\triangle e_n$, we produce an alteration in u_p of

$$\triangle u_p = \frac{g_n \triangle e_n}{G} \qquad (10)$$

so that $$g_n = \frac{G \triangle u_p}{\triangle e_n} \quad \text{mhos.} \qquad (11)$$

Similarly, in equation (3) a change of e_p produces a change in u_n of

$$\triangle u_n = -\frac{g_p \triangle e_p}{G} \qquad (12)$$

from which $$g_p = -\frac{G \triangle u_n}{\triangle e_p} \quad \text{mhos.} \qquad (13)$$

Consequently, to make this test we introduce suddenly as large a variation in e_p, and then in e_n, as the system will permit. The corresponding changes in u_n and u_p are noted. From these g_n and g_p may be computed as above.

Thus, in the case considered, let e_p be suddenly increased from 117 to 123 volts, e_n remaining at 120. The potential at the opposite side of the system would correspondingly fall from $u_n = -156.32$ volts to $u_n = -159.48$ volts. Again, let e_n be suddenly increased from 117 to 123 volts, e_p remaining at 120. The potential at the opposite side of the system would correspondingly rise from $u_p = 81.47$ volts to 82.73 volts—

by (11) $$g_n = 0.019 \times \frac{1.26}{6} = 0.004 \text{ mho}, \therefore r_n = 250 \text{ ohms}.$$

by (13) $$g_p = -0.019 \times \frac{-3.16}{6} = 0.010 \text{ mho}, r_p = 100 \text{ ohms}.$$

Equation (9) supplies a check to these two values. Finally, $g_o = G - (g_n + g_p) = 0.019 - 0.014 = 0.005$ mho, $\therefore r_o = 200$ ohms. Consequently, when a change in the E. M. F. on one side of the system produces very little change in the opposite potential, the leakage on that side is small compared with the total leakage of the system, and *per contra*.

The measurement is best conducted with the aid of storage batteries; otherwise, the variations ordinarily occurring in the pressures between bus-bars may mask the changes effected as described. If the test is conducted during the daytime the temporary disturbances of pressure it produced over the system will not be so objectionable.

As another example of the application of the method, suppose a three-wire system and the following observations made at the central station:

$e_p = 120$; $e_n = 120$; $u_n = -91\frac{3}{4}$ volts.

A leak of 10 ohms, $g = 0.1$ applied at n changed u_n to $-74\frac{1}{3}$.

$e_p = 120$; $e_n = 117$ changed to 123, u_p changed from -91 to -92.5.

$e_n = 120$; $e_p = 117$ changed to 123, u_n changed from $146\frac{3}{4}$ to $149\frac{1}{2}$.

Required the insulation resistance of the three main conductors.

Here by (8) $G = 0.1 \left(\frac{-74.33}{-91.75 + 74.33}\right) = 0.427$ mho $= 2.34$ ohms.

By (11) $$g_n = 0.427 \times \frac{2.75}{6} = 0.196 \text{ mho} \qquad = 5.10 \text{ ohms}.$$

By (13) $$g_p = -0.427 \times \frac{-1.5}{6} = \frac{0.107}{0.303} \qquad = .35 \text{ ohms}.$$

$$g_o = \frac{0.303}{0.124} = 8.06 \text{ ohms}.$$

In cases where one conductor is grounded through a small resistance, the leakage conductance of that conductor, and therefore of the system, becomes so large that the method fails. It is always possible, however, to measure the resistance of the leak in the grounded conductor, including the resistance of the conductor up to the ground.

Thus in Fig. 2, let G be the ground on the neutral conductor, through a small resistance r_o, A, is an ammeter, and r a suitable resistance of German silver or other alloy of constant resistance; S is a ground-switch for making good connection between ground and the neutral bus. Then the current i, through the ammeter, will be, with switch open,

$$i = \frac{e_p}{r + r_o} \text{ amperes} \qquad (14)$$

with the switch closed $$i^1 = \frac{e_p}{r} \text{ amperes} \qquad (15)$$

$$\therefore r_o = r\left(\frac{i - i^1}{i}\right) = \frac{e_p}{i^1}\left(\frac{i - i^1}{i}\right) \text{ ohms}. \qquad (16)$$

or $$g_o = g\,\frac{i}{i - i^1} = \frac{i^1}{e_p}\left(\frac{i}{i - i^1}\right) \text{ mhos} \qquad (17)$$

Thus a three-wire system with uninsulated or imperfectly grounded neutral, and E. M. F. e_p — 120 volts gave 11.43 amperes with the neutral ground-switch open and 12 amperes with the switch closed, the resistance, r, being 10 ohms ($g = 0.1$).

By (17) $$g_o = \frac{0.1 \times 11.43}{12 - 11.43} = \frac{1.143}{0.57} = 2 \text{ mhos}.$$

$$r_o = \tfrac{1}{2} \text{ ohm}.$$

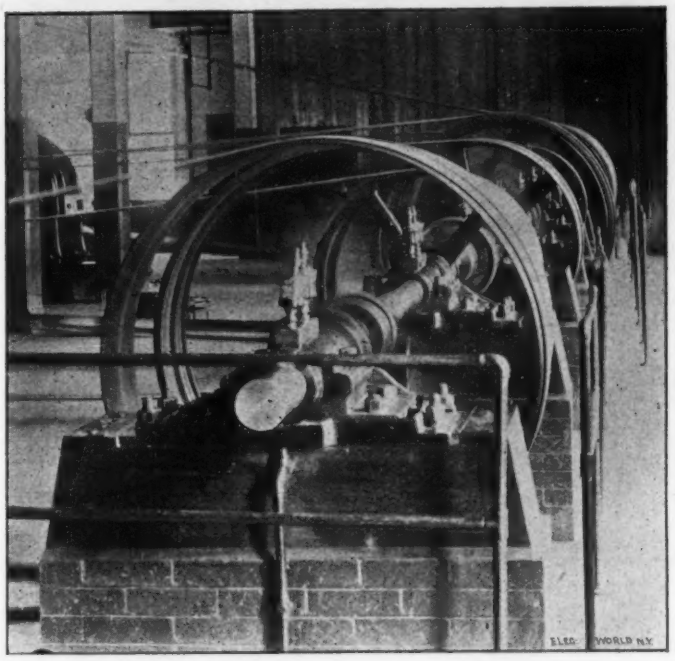
RÉSUMÉ.

The means of determining the joint leakage conductance of a three wire system are already known, but no means appear to be known for determining the individual-leakage conductances of the three separate conductors under load, except by the use of the Wheatstone bridge. It is here shown (1), how the individual-leakage conductances may be approximately determined by varying the working pressure on one side of the system and observing the corresponding variation of potential to ground on the other. (2) how the resistance in and up to the ground of a grounded conductor under load may be measured from the central station.

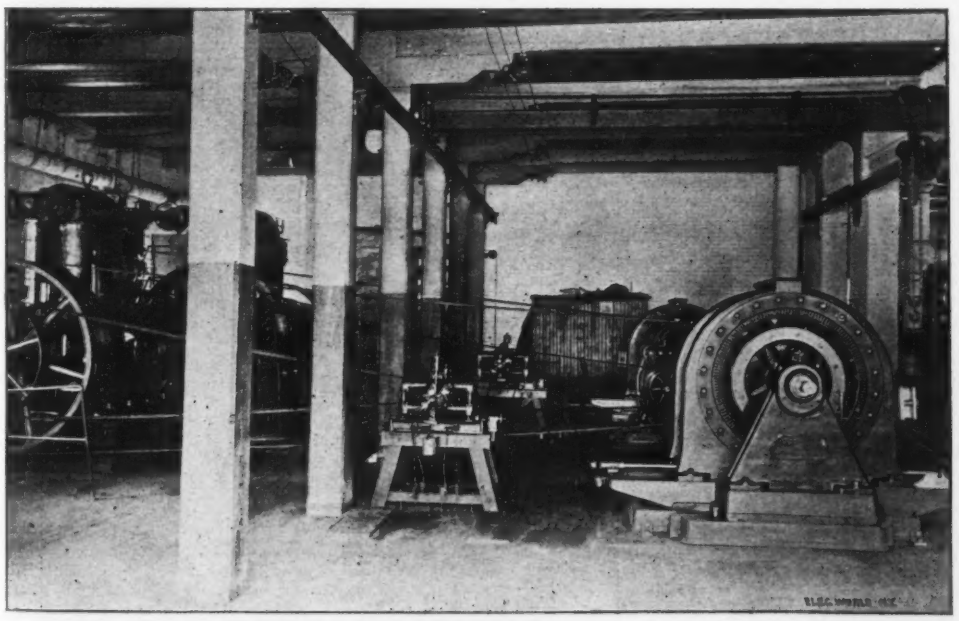
The Pittsfield Electric Company.

THE Pittsfield Electric Company supplies to consumers light, power and steam heat, which has proved a profitable combination. They also supply power to the local street railway system of Pittsfield.

The boiler plant consists of five horizontal tubular boilers, three of which are rated at 125 horse-power and are 18 feet long and 72 inches in diameter. The other two are of 100-hp capacity and are 16 feet long. They are arranged in one row, as shown in the illustration. The flue gases pass first to a long header, which in turn carries them to a circular brick stack 95 feet high and 48 inches internal diameter. The grates of the boilers are provided with hand shakers and automatic dampers. About 10 tons of soft coal are daily consumed. The feed-pipe system, although not duplicated, is so arranged that many of the advantages of a duplicate system are obtained. All the pumps are of the Worthington type and are supplemented by a Kortings and Metropolitan injector. The feed water is very good and no trouble is experienced due to either corrosion or scale, thus allowing of the use of an iron system of feed piping with complete success. Five of the engines are of the Westinghouse type and operate at 100 pounds pressure and are directly belted to the dynamos, while the sixth is a double Harris-Corliss, which drives a jack shaft to which several dynamos are belted. Two of the Westinghouse engines have a stroke of 11 inches, a high-pressure cylinder of 11 inches and low-pressure cylinder of 19 inches and run at 300 revolutions per minute. Another Westinghouse compound has a stroke of 14 inches, high-pressure cylinder, 14 inches; low-pressure cylinder, 24 inches, and runs at a speed of 280 revolutions per minute. The fourth has a stroke of 16 inches and the same dimensions of high-pressure cylinder, and a low-pressure cylinder of 27 inches and runs at 250 revolutions per minute. The fifth Westinghouse standard engine, 11 x 10, runs at 340 revolutions per minute. The W. A. Harris double-Corliss engine, 16 x 42 inches, runs at a speed of 87 revolutions per minute. It is provided with a 20-foot fly-wheel having a 38-inch face, driving a long jack shaft, as shown in the illustration. The jack shaft runs at 340 revolutions per minute and has eight bearings mounted on brick piers and provided with sight feed oil cocks. The shaft is 4½ inches in diameter, excepting between the bearings carrying the driving pulley where it is 5½ inches. To it are belted a Westinghouse railway generator, a number of small exciters, a 45-light T.-H. arc machine, a direct-current power generator and a 100-kw S. K. C. two-phase alternator. To the small compound engines are belted horizontal-type railway generators and a 75-light Wood arc machine, while the two larger Westinghouse engines each drive a 100-kw S. K. C. two-phase alternator, the larger engine carrying also a 75-light Wood arc machine. The standard Westinghouse engine drives a direct-current power generator. The most modern and interesting lighting machines are the S. K. C. 180-kw alternators. They are directly belted, as shown below, are of the inductor type and supply two-phase currents for both light and power. So satisfactory is this service that the company is making every effort to discard its direct-current power system and use instead the two-phase system. They run at the normal frequency of 16,000 periods per minute or 660 revolutions and deliver their output at 1000 and 2000 volts by a mere change of connections at their terminal boards. Each is excited by a small dynamo of the Westinghouse horizontal type. In addition there is a direct-current arc system and also a direct-current power system which operates at 300 volts. It is this latter which the company hopes shortly to do away with altogether.



JACK SHAFT.



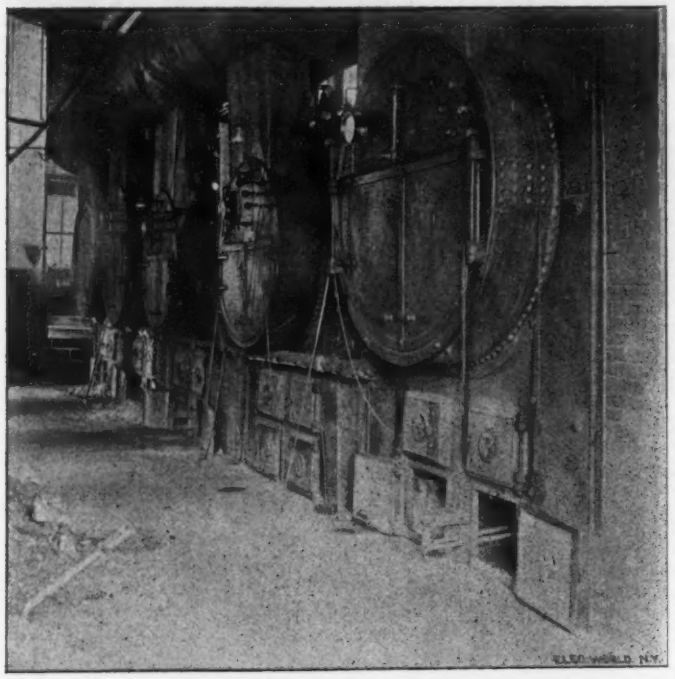
DYNAMO ROOM.

The currents of all the machines are delivered to large skeleton switchboards upon which the necessary switches, instruments and controlling resistances are appropriately arranged. The alternate-current load is distributed over the lines with a 2 per cent. loss and subdivided by Stanley transformers from 5 to 100 amperes capacity. There is also a series incandescent lamp-load of 40 lamps.

The poles are of wood, excepting in the main streets, where steel poles are used. The most distant point from the station is about four miles. The alternate-current power load in the daytime is 85 amperes at 1000 volts. At 6 o'clock this is reduced to about 25 amperes, while 80 amperes of lighting load comes on. During the Winter the latter amounts to about 230 amperes. Shallenberger meters are used for the lighting service and Thomson recording watt-meters for the power service. One of the direct-current power generators is usually fully loaded during the day.

The arc service consists of 159 lamps, divided into six circuits, of which one includes 75 lamps operated in series. The Wood arc machines are run at 920 revolutions and supply the 75-light circuit. The exhaust steam of the station, after passing through a horizontal heater made by Robbins, Gamwell & Co., enters a steam-heating system, which supplies adjacent buildings within a quarter of a mile radius. The condensed steam is pumped out by means of a Worthington pump, and then passes through a Hine & Robertson grease extractor which removes the oil from the steam before it again enters the heater and is fed into the boilers. Means are also pro-

vided for exhausting into the atmosphere, if required. The heating is charged for by the number of cubic feet heated, and it is found that by this method of disposing of exhaust it is worth more than if a condenser and cooling tower were used. The underground steam mains are well covered, and have caused little or no trouble. The



Boiler Plant.

back pressure on the engines is slight and does not amount to more than two pounds.

The power-house is a substantial brick building, and is provided with rolling cranes for moving the heavy machinery.

Negative Resistance of the Arc.

In a recent communication to the London *Electrician*, Mr. Blondel states that when it was first heard of, the negative resistance of the arc was generally supposed to be a joke, and the fun of it was appreciated fully. But the recent discussion before the Physical Society showed that it was not a joke, and that, unlike "aruspices" in ancient Rome, modern worshipers of "Negativity" are really in earnest. Since they do not find any absurdity in the idea of a negative resistance, we must be prepared for the worst, and expect to be shown next a body with a negative mass and a light with a negative candle-power.

"Let V be the difference of potential between the carbons, E the E. M. F. lost at the surface of the carbons (called, wrongly, I think, 'back' E. M. F.), R the resistance of the arc, C the continuous current, A the alternating current. The equation of the arc with the two currents is,

$$V = E + R\,(C + A),$$

where C is a constant, R and A variables. We get by differentiating,

$$dV = dE + RdA + AdR.$$

E is accepted as a constant by Messrs. Frith and Rodgers, and is most probably so, since it represents the work expended in the volatilization of carbon. Hence the following relation remains:

$$\frac{dV}{dA} = R + A\frac{dR}{dA}.$$

"The authors forgot the existence of the last term when dealing with the variable resistance of the arc as with a constant resistance, and wrote $R = dV/dA$. But in reality this relation is *not* the true resistance of the arc, and consequently all their conclusions are void. That the arc may be cooler than the crater does not prove, moreover, anything in favor of negative resistance, but only shows a loss by radiation. I hope that, when they reconsider the whole matter, the authors will admit that their negative resistance was only the result of a mistake in definition, and will be satisfied with our gratitude for the interesting experiments they brought before the electrical public."

The Jacques Carbon Battery.

BY C. J. REED.

From the description and data given of the Jacques so-called "carbon-consuming primary battery," it seemed evident to the writer that the electrical energy derived from this cell, instead of

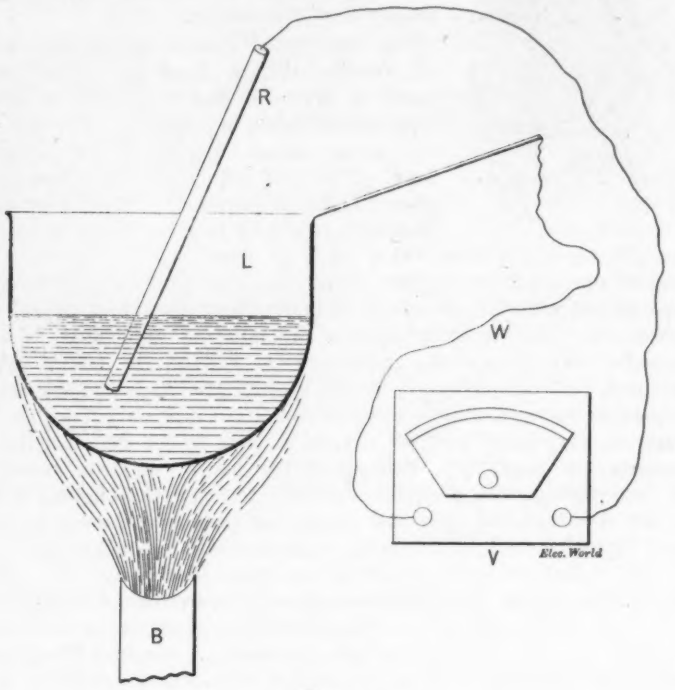


Fig. 1.

being evolved directly from the carbon, was produced by a thermo-electric junction. To determine this question three experiments were performed, the results of which indicate clearly that the action is thermo-electric.

The apparatus used in the first experiment is shown in Fig. 1. It consisted of a sheet-iron cup, L, having a long iron handle, to which a wire, W, was soldered. The free end of the wire was connected to one terminal of a Weston voltmeter, V. The cup was half filled with pure caustic soda and heated by the flame of a Bunsen burner, B. The other terminal of the voltmeter was connected by a flexible wire to a conducting rod, R, the end of which was at frequent intervals inserted into the fused soda.

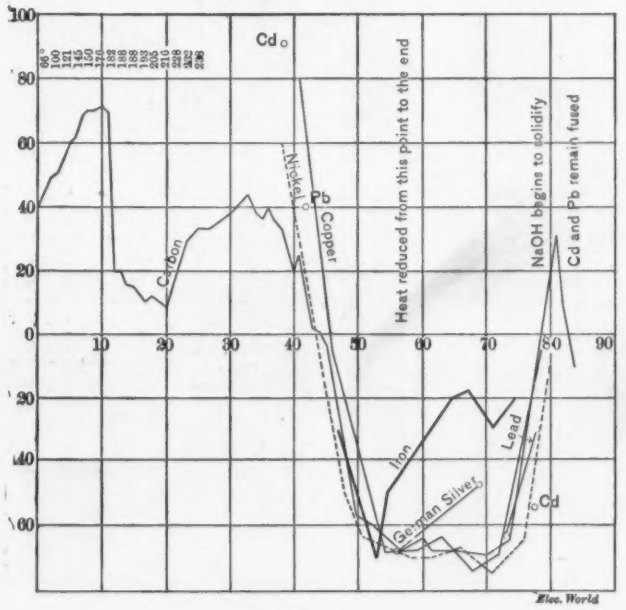


Fig. 2.

Rods of carbon, nickel, copper, iron, German silver, lead and cadmium were used. The reading of the voltmeter was taken as quickly as possible after bringing the rod in contact with the alkali. The rod was withdrawn after each reading and allowed to cool.

Readings were taken in this manner at intervals of one minute from the time the alkali fused until it attained the highest tempera-

ture, and afterward until it cooled to the point of solidification. The results are shown in Fig. 2, in which the ordinate represents E. M. F., the unit being .01 of a volt, and the abscissa represents time in minutes from the beginning of the experiment.

The temperature gradually increased from 66 degrees C., at which the alkali melted, to nearly a red heat. It was then gradually reduced by turning down the flame and finally removing it.

It is well known that sodic, as well as a potassic, hydrate contains considerable water, which, after fusion, is gradually evaporated as the temperature increases, until at a red heat the water is nearly, though not quite, all expelled.

A mercurial thermometer was used at the beginning of the experiment, the last reading being taken at 238° C., as shown in Fig. 2, at the end of 18 minutes.

In this experiment readings were not taken with the metal rods during the first 38 minutes, the original intention being to use only the carbon rod. The general coincidence, or at least similarity of the carbon curve with the metal curves, so far as they were taken, indicates clearly that there is no essential difference between them, and that the seat of E. M. F. is the same, whether the rod be of carbon or of metal. The maximum E. M. F. obtained from some of the metals is noticeably greater than that obtained at any point from the carbon.

Only two observations with the cadmium rod and three with the lead rod were made, in all of which the metal melted almost immediately on touching the alkali. The first reading of the cadmium, taken at the 39th minute, showed it to be positive to the cup and the E. M. F. to be 0.90 volt. The second reading at the 77th minute showed it to be negative to the cup and the E. M. F. force to be 0.58 volt.

The first reading of the lead rod at the 42d minute showed the lead positive and the E. M. F. 0.40 volt. The second and third readings at the 73d and 78th minutes showed the lead to be negative and the E. M. F. to be 0.64 and 0.30.

The reversal of polarity or change from positive to negative at a temperature a little below a red heat is particularly interesting and

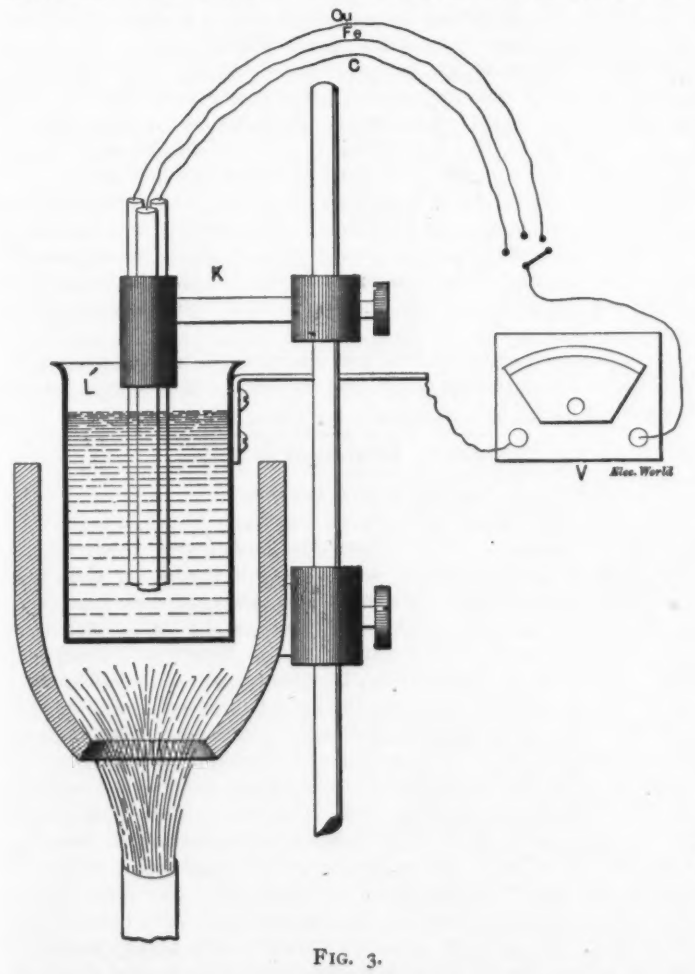


FIG. 3.

is, the writer believes, a sufficient proof that the action of the cell is thermo-electric and not galvanic. It is in accordance with the thermo-electric behavior of all substances, but cannot be reconciled to any rational theory of galvanic or chemical action. It cannot be possible therefore that the energy of the current in the case of carbon is derived from the consumption of the carbon rod. A careful examination of the carbon (arc-light carbon) rod before and after the experiment, and also after prolonged use in other experiments,

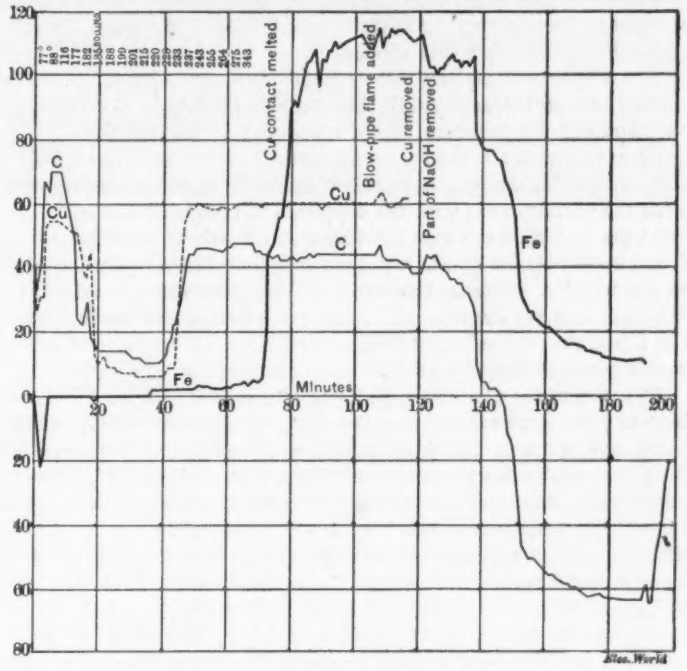


FIG. 4.

showed not the slightest indication of any change such as combustion would produce. The finest lines on its surface, formed in the process of manufacture, were unaltered by the experiments, and that part of the rod which had been immersed in the alkali could not be distinguished by its appearance from that which had not been immersed.

The curve for the iron rod indicates that the rod and cup, both being of iron, do not constitute the elements of the thermo-electric junction. A reasonable theory would be that the junction between the heated cup and the alkali is the thermo-electric junction, and that the rod acts merely as a conductor to connect the alkali with the external part of the circuit. On this theory we should expect what we find by this experiment to be the case, viz., that the substitution of rods of various metals for the carbon rod makes no essential difference in the result.

It will be noticed in Fig. 2 that after about 45 minutes the polarity of all the rods reversed from positive to negative, and that the rate of change of E. M. F. at that point was very rapid.

After 58 minutes the flame was turned down, and the temperature gradually reduced. As the temperature fell the E. M. F. also fell, and after 78 minutes the carbon again reversed, becoming positive. It reached a positive maximum of 0.31 volt and again reversed, being — 0.10 when the alkali became entirely solid. The cadmium and lead that had melted off the rods and dropped into the cup still remained fused when the experiment came to an end after 84 minutes.

During the course of this experiment it was noticed that on dipping the conducting rod into the alkali with the voltmeter connections closed, the deflection of the needle, instead of remaining constant, changed rapidly and irregularly as the end of the rod became hot. The highest reading obtainable was the one recorded and used in constructing the curves of Fig. 2.

In order to compare more accurately the results obtained from rods of different materials and to make the comparison under conditions as nearly uniform as possible, a second experiment was performed with the apparatus shown in Fig. 3.

The cup, L^1, was of sheet-iron, cylindrical in form, 2 inches in diameter and 2½ inches deep. It was filled to a depth of 2 inches with impure caustic potash. The cup was partly enclosed in a plumbago crucible of larger diameter, the bottom of which was removed. The handle of the cup was connected, as in the previous experiment, with one terminal of the voltmeter.

Three rods, one of carbon, one of copper and one of iron, each 12 inches long and ¼ inch in diameter were insulated by sheet asbestos and held close together in a vertical position by a suitable clamp, the lower ends of the tubes dipping into the fused alkali. Each rod was connected by a separate wire to one contact piece of a three-point

switch connected to the voltmeter, as shown in Fig. 3, in such a manner that connection through the voltmeter could be rapidly changed from one rod to another.

The alkali was first fused in the cup and allowed to cool. The rods were then brought in contact with the solid mass and the flame of the Bunsen burner was applied.

The copper and carbon rods indicated a positive E. M. F. immediately, which increased until the alkali fused, when it reached 0.40 volt and the temperature of the mass was 77 degrees C.

From that point a reading was taken every minute from each of the three rods, the contacts being made in rapid succession, first with the carbon, next with the copper, and then with the iron.

At the end of 48 minutes the water was nearly all expelled and the fused mass became quiet. At the same time the temperature began to rise rapidly. The last reading of the thermometer, taken at 38 minutes, was 343 degrees C. After 70 minutes the solder joining the top of the copper rod to the conducting wire melted and contact was afterward made by hand.

At 104 minutes the blow-pipe flame was substituted for the Bunsen burner; but it was found that the temperature could not be further increased on account of the rapidity with which the heat was conducted away by the copper rod. The copper rod and a part of the alkali were therefore removed a few minutes later. The temperature then rapidly rose to a bright red heat, while the E. M. F. of both the carbon and the iron fell, the carbon reversing and attaining a negative maximum of 0.65 volt. The results are graphically shown in Fig. 4.

The curves show that the highest E. M. F. was produced by the iron rod, and that at a certain temperature a little below a red heat it gave 1.15 volts.

This remarkable E. M. F. can be due only to the difference in temperature between the two junctions of the alkali and iron; the lower and hotter junction being that of the alkali and iron cup, the upper and colder junction being that of the alkali and iron rod. The difference of temperature between these two junctions could not under the circumstances have been very great, probably not over 100 degrees C., and possibly very much less. Hence, the thermo-electric power of this junction between iron and alkali must be enormous compared with that of thermo-electric couples composed of any two metals.

During the interval between the forty-fourth and the eighty-ninth minute observations were also made by momentarily dipping into the alkali cold rods of copper, iron and carbon. These readings, when compared with the simultaneous readings of the hot rods, show that the E. M. F. is greater with the cold than with the hot rods. Curves from the readings of the cold rods are shown in Fig. 5.

The average of all readings for each of the hot and for each of the cold rods taken during this period is given in tabular form below:

	Hot.	Cold.
Carbon	.41	.80
Iron	.14	.42
Copper	.57	.58

While these figures should be relied upon only as a qualitative

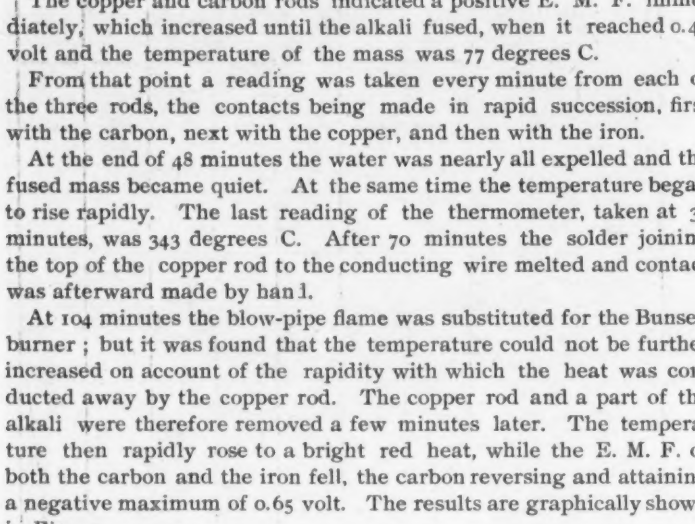


Fig. 5.

guide, they are sufficient to show that the greater E. M. F. is obtained with the cold rods, or that the E. M. F. is increased by increasing the difference in temperature between the upper and lower junctions.

The blast of air used by Dr. Jacques undoubtedly contributed toward increasing this difference in temperature, and hence the E. M. F. of his battery. The writer found also that a jet of illuminating gas has the same effect. This would seem to dispose of the theory that the E. M. F. is a result of an oxidizing effect of the injected air upon the carbon rod.

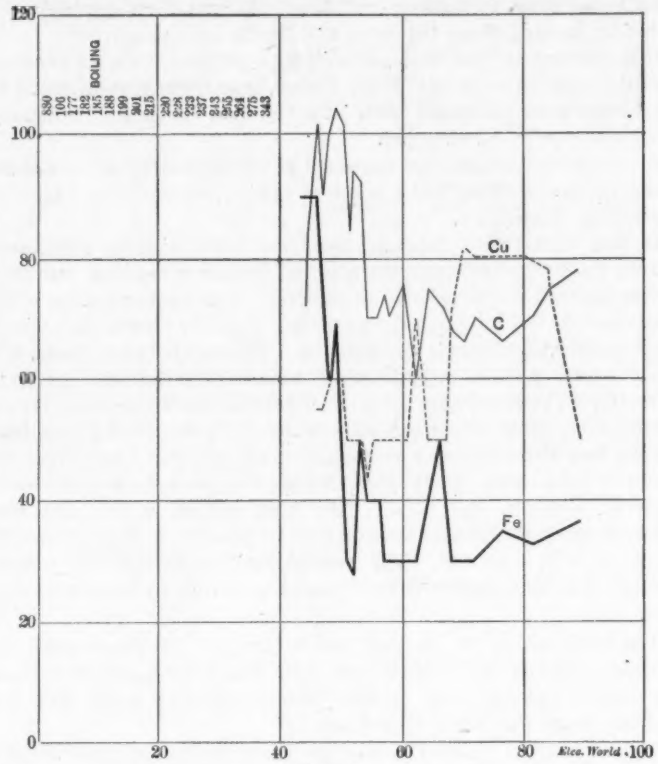


Fig. 6.

In the third experiment the apparatus shown in Fig. 3 was used, the rods being replaced by a long piece of iron gas pipe, which was bent into a narrow U, the bottom of the U dipping into the alkali. A blast of cold air was continually blown through the pipe, and pure caustic soda was used. The results are shown in Fig. 6.

At the end of half an hour it was found that a red heat could not be obtained, even by using the blast lamp, on account of the cooling effect of the air passing through the iron pipe. The E. M. F. reached only 0.40 volt. A portion of the sodic hydrate was therefore removed and the gas pipe was raised up until it barely touched the fused caustic. The temperature then rapidly increased to a bright red heat and the E. M. F. rose to 0.94 volt, the highest that could be obtained.

In this experiment, as in the previous one, the iron pipe remained positive to the cup; while in the first experiment the iron rod became negative at a high temperature.

Improving Röntgen-Ray Tubes.

To the Editor of The Electrical World:

Sir:—In some experiments recently made on Röntgen rays I have used the Wimshurst influence machine, having two ebonite plates each eight inches in diameter with 32 tinfoil sectors on each plate and the usual condensers attached. The tubes are connected to the outside tinfoil coatings of the condensers and a spark maintained between the terminals of the machine. A spherical German glass tube, two inches in diameter, has been employed, the small anode of which is sunk in the bottom and the large cathode placed to one side near the walls, both being of aluminum. In trying this tube it was found to have a very low vacuum and after having repumped it I found that it still gave very poor results. When the terminals of the Wimshurst machine were put one or two inches apart the cathode discharge scattered throughout the entire tube excepting opposite the cathode, and with the exception of this position the fluoroscope became illuminated in all positions. The entire surface of the tube excepting opposite the cathode was then covered with red sealing wax, being given a very heavy coating. Upon connecting the tube to the influence machine, it was found that the radiations from the surface of glass exposed were comparatively strong, and that the fluoroscope became illuminated with a very bright light. No trouble was experienced with the heating or melting of the wax. I was thus able to make from a poor tube one giving good results.

Alfred G. Dell.

Baltimore, Md.

CONVENTION OF THE NORTHWESTERN ELECTRICAL ASSOCIATION

MARINETTE, WIS. JULY 15 & 16TH 1896.

FIRST DAY.

WEDNESDAY, JULY 15.

The fourth semi-annual convention of the Northwestern Electrical Association was opened by the president, Mr. W. B. Baker, and the roll call of the secretary showed 21 active members, seven associate members and two corporation members present.

The president in his address suggested that the secretary keep a record of the rates charged in each city within the limits of the association, and that whenever a member desires information regarding other places he may obtain it from the secretary. He believed that a closer relationship should exist between the electric light and insurance companies, which would work beneficially to both parties. He stated that while in all cities there is a large amount of poor wiring, which for the benefit of the plants themselves should be changed, still in some cases the insurance companies are putting a burden upon the electric companies.

The chairman of the Insurance Committee reported that several meetings had been held.

Resolutions expressing sympathy for the families of Mr. Hall, Mr. Gunderson and Mr. Sullivan were presented and adopted.

Nine new names were submitted for membership and favorably acted upon.

In the absence of Mr. W. Clyde Jones, his paper on the "Rights of Electrical Companies" was read by the secretary. In this he stated that the object of the paper was to outline the course of judicial decision, which would, he thought, be of service to business men and engineers engaged in electrical pursuits. The subject of the paper was divided into three heads: 1. The relation of the electrical industry to the governing power upon whom it depends for the exercise of the essential franchises for the use of streets and highways. 2. The relations to private persons and abutting property owners. 3. The relations between various companies, electrical and otherwise, which conflict in the exercise of their franchises. It was stated that the obtainment and enjoyment of a franchise brings the electrical company into contact with the governing power of the community; that all such granting power lies primarily in the State, subject to the restrictions of the Federal Constitution and lawful statutes of the United States, the grants being made subject usually to control by the municipal authority as to the manner in which it is to be exercised. Although the Government may permit a company to exercise a franchise, the franchises cannot be exercised in derogation of the rights of others without due compensation. The author then traced through the various stages of street rights, beginning with the time when people first began to live together in communities, when the right of way was granted to those carrying burdens, the use of pack animals, the right of way of vehicles, the use of stage coaches, the necessity of transportation in long defined routes, and the laying of rails in the streets. The courts have generally held that the horse railway is a proper use of the streets for the original purpose of transportation, and does not impose any burden necessitating compensation to abutting property owners. Then followed the substitution of mechanical power for the horse in the form of steam motors. These, however, have been held by the courts not to be the proper use of the street. The use of a cable system and conduit have been upheld by the courts as imposing no new burden. The question whether the poles and overhead construction of electric railways imposes a new burden has been a long fought battle, resulting in both affirmative and negative decisions, the tendency being, however, toward the use of such poles and wires, for which the abutting property owners must not be compensated. The elevated road requires a superstructure which the courts have held to be a special use of the street, introducing a new servitude, and that property owners are entitled to compensation. The use of the street for sewage, water pipe supply and gas pipes, is a proper use, even though the mains are used incidentally for supplying private customers. With the introduction of electric lighting, an objection also arose to the use of the street, but where the plant is owned by the municipality it has been deemed a proper use; where owned by private parties, some courts have held it to be a proper use and some the contrary. The weight of authority is in favor of the view that the telegraph and telephone are without the scope of the proper use of the street, and is such a special use that the abutting property owners are entitled to compensation for the new servitude.

In the conflict between the telephone and electric railway it was pointed out that the latter was a use of the street for the purpose of transportation, while the telephone was a use not allowed for in the original purpose of the street and therefore subsidiary. The prevailing opinion is that the telephone company can prevent the disturbances by the adoption of a metallic circuit, and since no one can have exclusive monopoly to the use of the earth as a conductor and as the double trolley system is not at the present stage thoroughly practicable, the telephone company should change to the metallic circuit. The advantages in the use of the metallic circuit for telephone service are becoming more appreciated and this decision against the telephone is not felt as a hardship. Another serious conflict arises between the electric railways and water and gas mains. Suits have been brought against the electric railway companies for damages done to the mains, but no ultimate decisions have been reached. It is argued by the owners of these mains that the electric railway companies must use their own franchise in a manner not to interfere with the rights of others, and if the use of the ground as a part of the electric circuit results in the destruction of the mains, provision must be made to prevent such destruction or the use of the earth must be abandoned. It is also argued that the use of the street for gas and water mains is recognized as a proper use and as the franchise for such was in most cases prior to that of the electric railway, such use takes precedence. On the other hand, it is argued that the use of the street for railway is within the original purpose of the street, while the use of the mains is without such purpose and therefore is a secondary use. It would seem therefore to be the duty of the electric railway companies to operate their system so as not to interfere with the mains laid in the street, and if the use of the ground circuit is essential, to devise some means to prevent deleterious action of the pipes.

The next paper was on the "Insurance of Electrical Plants," by Mr. R. H. Pierce, and was read in his absence by Mr. Cutter. The author stated that as a good share of the existing stations needed to be rebuilt in order to have a decent earning capacity, the loss of the plant may in many cases be considered less of a hardship than the loss through the interruption of service and the attendant loss of revenue and patronage. He stated that the question of insurance can be met in three ways: First, by insuring in responsible and reliable insurance companies; second, by the formation of a mutual company by central station owners; third, by securing the maximum safety, by the use of proper construction, care and fire protection, and taking the chances of a fire loss. The first he considered to be the one to be generally followed. If fire insurance, he stated, is a legitimate business, then we may as well assume that the insurance people knew their business, and that the competition between the insurance companies will produce as low a rate as could with equal protection be given by a mutual company, consisting of the owners of central stations.

The great problem is how best to secure safety. Competition has led to cheapness in construction in both appliances and methods. He then enumerated the rules of the underwriters regarding central stations. He said that by conforming to these rules the insurance rate is very low and eagerly sought by insurance companies. The best rate is 50 cents per $100. For every point in which the station fails to conform to the requirements, a certain addition is made to the rate. The underwriters recognize 34 specific causes for raising the rate above the base or minimum amount, and consist of viola-

tions of the rules and regulations, not considering external fire protection, "other occupancy," "condition," and "exposure." For inadequate fire protection the rates may be raised as high as $10 per $100, of which more than one half may be due to the following causes: Improper arrangement of stack, defective wiring, improper construction of switchboard, improper construction and placing of rheostats; storage of oils, gasoline, etc., and improper storage of ashes. All of these defects can and should be always avoided. In most cases the station can be designed or remodeled by one familiar with the underwriters' requirements so as to have a very low total rate and without any extravagant expenditure, and where the surroundings are favorable a station can be cheaply built which can be insured for the minimum rate or very close to it. He concluded by stating that the solution of the insurance problem was intelligent construction and operation, and the way to install plants is to determine and study carefully and discuss freely the requirements of the National Board of Fire Underwriters.

The president appointed a committee to consider the recommendations contained in his opening address. He instructed the secretary to obtain and keep statistics in regard to the rates charged by central stations. Twenty-eight towns in the State of Illinois had already submitted reports.

Mr. Lord stated that what was desired was the rates paid by different cities throughout the territory covered by the Association, so that each member could have a basis on which to establish rates.

The meeting was then adjourned until July 16.

SECOND DAY.

THURSDAY, JULY 16.

The convention was called to order by the president, and the first business transacted was to elect five new members.

A paper was then read by Mr. Mercein on the New York Convention and Exposition. Mr. Mercein said that he had been appointed by the president of the Board of Directors to represent the association at the May meeting of the National Electric Light Association in New York. He thought that the subject of municipal lighting and ownership should have been brought before the National Association and thoughtfully and carefully considered. He trusted that at an early date a joint meeting of delegates of the National, Northwestern, Southwestern, Canadian and other kindred associations should be held to discuss this matter and take action upon it. He considered that the papers presented at New York were too theoretical and technical for the average electrical education, and were not calculated to meet the demand for general practical information. The discussions were not at all spontaneous, and very few took part, and those largely at the solicitation of the presiding officer, an evidence that the subjects were not of general interest. He considered Mr. Ferguson's paper on "Acetylene Gas" the best which was presented, together with that of Mr. Rogers on the "Evolution of the Arc Lamp." He was struck by the almost aggressive manner of those desiring information. He said there seemed to be a desire to trip the author up, and many of the questions asked aimed apparently at his discomfiture. He objected to the rule of the National Association to have all papers presented prior to the holding of the Convention. He thought that such a method had serious defects, especially for the Northwestern Association. He thought that few men would submit their gratuitous papers to the advance criticism of any individual or committee, or consent to any alterations of their matter. He thought that the freshness and interest of the papers would be decreased if read beforehand by the members. The aim of the association is to secure personal attendance and to present something new to the members present. He considered that it was handicapping the lecturer to prematurely publish his paper. He thought that the one advantage to be obtained by submitting papers in advance was the opportunity to eliminate advertising and other objectionable matter. He thought there was but little general provision for the entertainment of delegates and visitors, although there were little dinners and club parties for the fortunate few. This was in marked contrast to the spontaneous courtesy and hospitality of the West with the comparatively strained and conventional manners of Eastern entertainers.

Mr. Beggs said in reference to Mr. Mercein's paper that he would challenge the National Electric Light Association to show a single thing that they had done for the benefit of central stations, and he still held that challenge open. He censured the committee appointed by the National Association for the purpose of considering the encroachment of manufacturing companies in the lighting field. He agreed with Mr. Mercein in believing that the papers presented before the National Association were entirely too technical. He thought they needed the practical talk of men who are dealing with conditions as they daily arise. He stated that the Ohio Association had passed resolutions pledging the members to discriminate against any concern interested in exploiting an opposition plant in the territory of any central station lighting company. He thought that the National Electric Light Association had a meagre and unrepresentative membership. They represented a few large companies in a few large cities, It is the hundreds of small companies all over the country that can make themselves felt and should make themselves felt. He believed that local organization was of far more value than the National organization, inasmuch as a great part of the work of the National Association is not applicable locally. He thought that when a company came in competition with another company in the State of Wisconsin, they did not care what was going on in Harrisburg, Baltimore and Boston; consequently, it is local statistics applying to local communities that are valuable. He thought that statistics on the whole were misleading, because so many factors are wanting, such as the rating of lamps and the hours of burning. He believed that the secretary was the proper person to get data from the members of the association, and that their local application will make them of extreme value. He believed that it is necessary to have a spontaneous discussion of all subjects coming before the meeting.

Prof. Jackson's paper on "Alternating-Current Motors" was read in his absence by Mr. Cutter. Prof. Jackson stated that the greatest possibilities of alternating-current central stations in cities of over 15,000 inhabitants as paying properties, require that the power circuit be operated to give the station a day load, and while the requirements of the power circuit are fully met by continuous-current distribution at 500 volts, many alternating-current central station men wish to avoid duplicating apparatus. Experiments had been carried on under his supervision with single-phase, two-phase and three-phase motors of about five horse-power. He considered that to the requisites for a good alternating-current motor stipulated by Silvanus P. Thompson, namely, First: It shall exert a good torque at starting. Second: It shall be capable of running at nearly constant speed at all loads. Third: It shall yield in mechanical power a high percentage of the power put into it, that is, have a high commercial efficiency; it should be added, (*a*) the motor shall have a high power factor. (*b*) It shall not require an abnormally large current from the lines at the instant of starting. (*c*) It shall not cause a large unbalancing of the pressures on the lines of a polyphase circuit. Four of the six motors tested affected the incandescent light circuit seriously and showed, he stated, the absurdity of attempting with them combined service on the same circuits. He considered that the question of power distribution from alternating-current stations, as it now stands, may be resolved as follows: First: If a continuous-current 500-volt power service is already installed, stick to it. Second: If a large power service can be developed within two miles of the station, put in a 500-volt continuous-current outfit. Third: If you can develop a large power service only and cannot afford to duplicate the apparatus, or distances are excessive, arrange for alternating-current motors. Fourth: If this is so, arrange to operate all the lamps on one phase to avoid difficulty in regulation, and use such a generator and system of lines as to enable the use of motors. Fifth: Motors intended for such use should be guaranteed to have a high power factor without taking an excessive current. This paper will be published in full in a subsequent issue.

Mr. W. R. Garton's paper on "Lightning Arresters" was then read. He stated that the fundamental principle of lightning arresters is some form of air gap. The only changes from original forms have been the addition of interrupting features which the different currents employed have necessitated, and it is on these latter that the successful or unsuccessful performance has depended. He stated that the air gap was almost universally employed. A fuse was sometimes added which would be blown upon flow of current. This was not, however, satisfactory. The air jet arrester, which automatically blows out the arc by a jet of air due to its sudden expansion, had proved inadequate. The magnetic blow-out had been recognized as fundamental. Other forms consisted in the use of mica washers, keystone, tank, etc. The latter applied only to railway circuits. He then described the tank arrester. He considered

that there were three standard form of arresters, the Wurts non-arcing, the General Electric magnetic blow-out and the Garton, of which he gave a brief description.

Mr. Beggs considered that it was not difficult to demonstrate to almost any municipality that the price at which private companies are willing to render service is as low or lower than they can render it themselves. He thought that some companies were, however, charging outrageous figures, which depended upon their pull with the municipal authorities. He thought that the statistics given out by Mr. Dow, manager of the Detroit municipal plant, were reliable. They showed a cost of $9 per arc-lamp per annum. He considered that the central station people of the country are far more powerful than the manufacturing companies. The electric light stations have within themselves all the elements necessary to manufacture their own apparatus if they are provoked to it. He said that the Association of Edison Illuminating Companies, which has done more for its members than any other association, had given almost its entire time during the last eighteen months to the question of incandescent lamps.

There is no lamp, he said, the candle-power of which is within 20 per cent. of its nominal rating, and that the economy of any lamp was over 30 per cent. out. Tests showed that lamps guaranteed not to exceed 50 watts were taking 56 watts on the average. The factors in an incandescent lamp are economy, candle-power and voltage, two of which can be fixed positively. The candle-power and voltage have hitherto been approximately correct, ignoring the economy. With the old Edison chemical meter it did not make so much difference. The Edison Illuminating Association had stated that if the manufacturer would guarantee to produce a two and one-half watt lamp having a life of 300 hours with a variation of candle-power not to exceed 20 per cent., in other words, allow the candle-power to fall down to 12.2 before its effective life has ceased, that was the lamp wanted. Mr. Beggs stated that it was impossible to get a lamp which would stand such a test of 300 hours. He said the time was coming when high economy lamps must be used. A 20 cp-lamp was needed to-day to compete with gas and the Welsbach burner. He considered a four-watt lamp a monstrosity which ought not to be permitted to be used. By reducing to a three watt lamp the capacity of the station was increased 25 per cent., without adding a dollar to the investment. In this way 25 per cent. more light could be furnished to the customer for the same rate as the lesser light, or you have increased the capacity of your plant 25 per cent., and have increased the profit proportionately if looked upon in that way. Mr. Beggs said that there is not a lamp manufacturer in the country who would dare take up a proposition to produce a 2½-watt lamp that will last 300 hours, standing under a candle-power of from 12.2 to 20. He stated that he sold his current at 15 cents per kilowatt-hour, which was equivalent to gas at $1.60 por 1000. He stated that the gas company sold gas for $1 per 1000. Mr. Beggs made a schedule of discounts on bills, giving 5 per cent. off for cash in five days, which discount extended to all bills. On bills from $5 to $10 he takes off 5 per cent. for quantity consumed, in addition to the previous 5 per cent. for cash. On bills from $10 to $20, 10 per cent.; from $20 to $30, 15 per cent.; from $30 to $40, 20 per cent.; from $40 to $50, 25 per cent., and above $50, 30 per cent., which with 5 per cent. off for cash brings the price exactly the same as that for gas.

Mr. Buckley said that manufacturers claimed they could not produce a lamp of 2½ watts and 300 hours, giving a candle-power within 20 per cent. of its rating at the present prices of lamps; that the lamps cost from 3 to 15 cents more to make.

Mr. Beggs stated that the Edison Illuminating Association had proposed that for each 5 per cent. that the lamp falls below standard value there shall be 10 per cent. deducted from the price of the lamp. If the lamp was 10 per cent. higher than the specifications, 5 per cent. more should be added, until for 100 per cent. more than the specifications 50 per cent. should be added. He thought that the central station companies would be the gainers even at this rate. He stated that 2½-watt lamps have been made which have burned for 1000 hours, but how it was done they did not know. They were accidents.

The Ways and Means Committee suggested that the term of delinquency be limited to one year instead of two, and that the secretary be formally instructed to draw upon all delinquents who are six months in arrears. Also that the president and directors of the association be authorized to incur any expense which in their judgment is necessary for the needs of the association. About $130 was raised by subscription to meet the indebtedness of the association to Mr. Lord and Mr. Schuette. The meeting then adjourned until 2 p. m., at which time a paper on "Insurance" was read by Mr. C. C. Paige. Mr. Paige stated that there was a time when insurance companies advised their policy-holders and the public generally that there was less liability to fire in buildings lighted by electricity than those lighted by any other method. It was not so now. The specifications for changes and improvements nowadays require the throwing aside of practically all old material. He said that in some cases electric service had been suspended on account of the failure of those interested to make the improvements required. The question therefore arises, are such changes necessary? He stated that in localities where the service had been installed and used for ten years not a single accident of any kind had occurred, and that such installations have been condemned. Poor material and improper workmanship have probably caused the insurance companies to be alarmed, even where losses have not occurred. He said that it was necessary to have central stations carefully supervise the installing of electric service.

Mr Doherty's report on recommendations suggested by the president was then read.

It was suggested that a Committee on Municipal Ownership make it its duty to collect facts and figures on the subject of municipal lighting, which will be of benefit to central station men. The report was adopted. A vote of thanks was tended to the Committee on Entertainment. Four new members were elected.

The meeting then adjourned until 9 o'clock, Friday morning, at which time the president appointed a committee for the purpose of soliciting new members. The name of the Legislative Committee was changed to the Protective Committee. The Convention then adjourned.

The members of the association and guests were entertained and banqueted at the expense of the Marinette Street Railway Company.

The following delegates attended the Convention:

L. C. Anderson, Fostoria.
H. Andrae. Milwaukee.
A. O. Baker, Sheboygan, Wis.
C. O. Baker, Anchor Electric Company, Chicago.
W. B. Baker, Waupaca, Wis.
John I. Beggs, Cincinnati.
F. N. Boyer, General Electric Company, Chicago.
W. P. Bragg, Monroe.
W. J Buckley, Fort Wayne Electric Corporation, Chicago.
A. C. Bunce, General Electric Company, Milwaukee.
L. W Burch, People's Electric Company, Madison.
Charles Cuno, Milwaukee.
George Cutter, Chicago.
Edward Daniell, Menominee, Mich.
E. L. Debell, Sheboygan, Wis.
Fred De Land, Chicago.
W. E. Donley, Westinghouse Glass Company, Chicago.
H. C. Higgins, Marinette, Wis.
L. E. Kerns, Madison, Wis.
P. H. Korst, Badger Electric Company, Racine, Wis.
R. F Kounty, Neillsville.
H. D. Latimer, Central Electric Company, Chicago.
I. P. Lord, Waupaca.
W. W. Lowe, Electric Appliance Company, Chicago.
G. S. McLean, Milwaukee.
Thomas R. Mercein, Milwaukee.
E. J. Mullen, Milwaukee.
C. C. Paige, Oshkosh.
T. A. Pamplion, Oconto.
John Schuette, Manitowoc.
M. L. Stevenson, Cleveland.
T. Weberling, Peru, Ind.
George B. Wheeler, Eau Claire.
O. B. Williams, Whitewater, Mich.
Charles C. Wilson, Fort Wayne Electric Corporation, Chicago.
W. Wilson, Chicago.
James Wolff, New York Insulated Wire Company, Chicago.

Those who went on the special train from Chicago were:

L. C. Anderson,
Julius Andrae,
C. O. Baker,
W. B. Baker,
F. W. Boyer,
Francis A. Brown,
George T. Caldwell.
P. A. Clisdell, General Electric Co.,
E. L Debell,
Fred. De Land,
Henry L. Doherty,
W. E. Donley,
J. H. Harding,
Joseph M. Hill, Wagner Elec. Co., Chicago,
H. Jones,
H. D. Latimer,
Irving P. Lord,
W. W. Lowe,
Thomas R. Mercein,
J. H. McGill,
George S McLean,
W. L. Morris,
J. Nansing,
C. C. Paige,
Frank Perry,
E. B. Smith,
George W. Wheeler,
O. B. Williams,
C. C. Wilson and wife, Fort Wayne Elec. Corporation, Chicago.
James Wolff.

Electrolysis of Water.

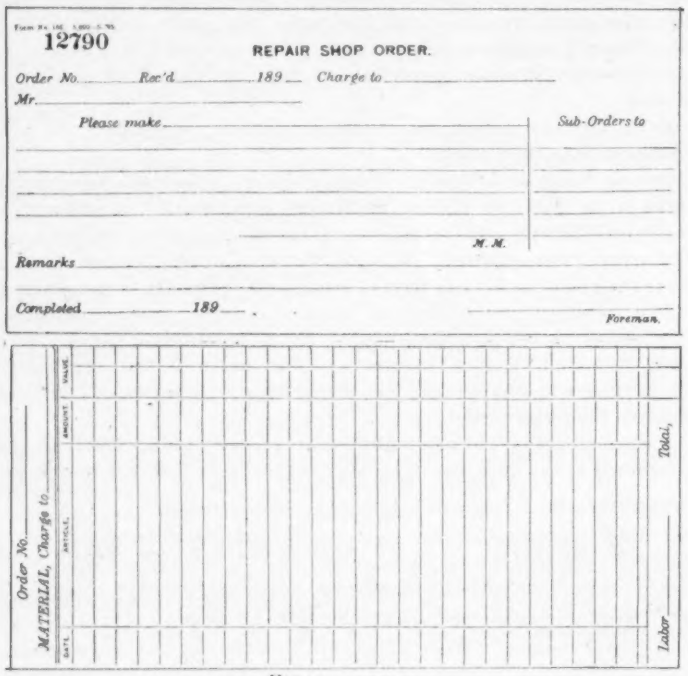
In a contribution to *Wiedemann's Annalen*, and abstracted in the London *Electrician*, A. P. Sokolow gives experimental proof that water can be electrolyzed with any E. M. F., however small. It all depends upon the pressure of the gas already existing at the cathodes. When the liquid is quite free from gases no inferior limit can be assigned to the necessary E. M. F. except zero. The author obtained electrolysis with an E. M. F. of about one hundredth of a volt. As a rule however it is difficult to show this on account of occlusion. He fused two thin platinum wires into the glass near the electrodes. Any dissociated gas at the latter would be carried by diffusion to the wires, and the polarization could be shown by an electrometer. This actually took place, although it required some hours to complete the action. This demonstrable fact verifies Helmholtz's prediction.

THE ELECTRIC RAILWAY

Street Railway Repair Accounts.

BY C. F. UEBELACKER.

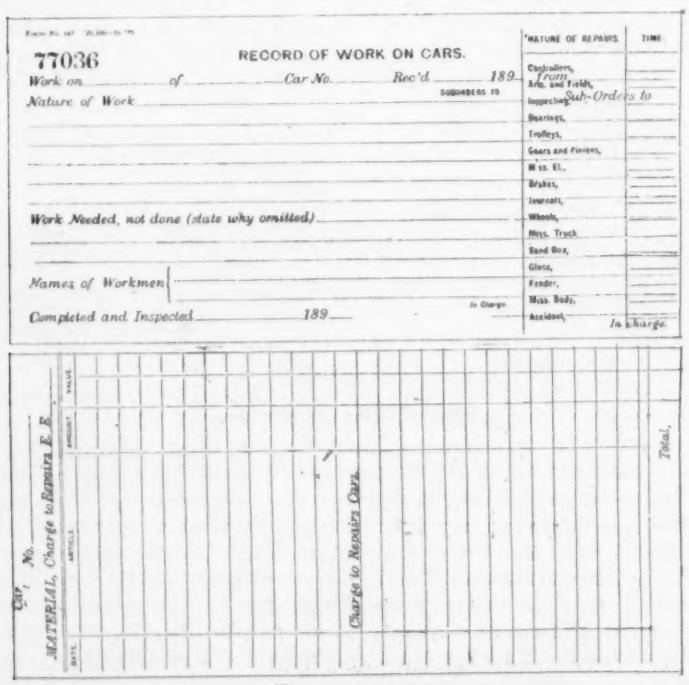
In order to procure maximum economy in the management of electric railways it is necessary to have a system of records by the aid of which variations in the cost from time to time may be compared and traced back to their immediate causes. It is the purpose



FIGS. 1 AND 2.

of this article to describe and explain a system which after having been carefully worked out has received the corrections and modifications suggested by a year's actual operation.

In the first place it is necessary to describe the fundamental basis upon which repairs are conducted. The railway in question con-



FIGS. 3 AND 4.

sists of a number of lines operated from several different and widely separated car sheds. At the centre of the system is located a repair shop equipped for handling all classes of repairs. The general plan is that all heavy repairs, that is, work requiring the jacking up of a car or the opening of a motor, is done at this shop. In addition to heavy repairs, all cars are sent to the repair shop at regular intervals of 40 days for inspection and overhauling. At the car sheds crews are employed for daily inspection, wiping, greasing, etc., and for small repairs only. When any small apparatus such as a canopy-switch, controller-drum or back fuse-box is disabled, the part is replaced by a spare piece, the old part being shipped to the shop.

A secondary object of report forms is to furnish a record of the service given by any piece of apparatus, or information as to when and by whom any piece of work was done.

The repairs are divided into three main heads, namely, motor repairs, truck repairs and body repairs. These headings are subdivided as follows:

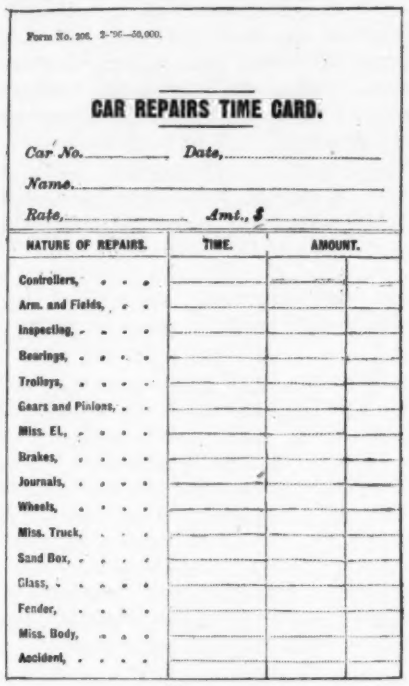


FIG. 5.

Motor repairs.—Controllers, armatures or fields, trolleys, wiping, greasing and inspecting, renewals of gears and pinions, renewals of bearings; miscellaneous electrical repairs.

Truck repairs.—Brakes, journals, wheel renewals; miscellaneous repairs.

Body repairs.—Sand boxes, glass, fenders, painting and miscellaneous.

In addition to the above an account is provided in which all repairs resulting from collisions, etc., are carried under the heading of "accidents." To provide for the separation of costs under their appropriate headings, a shop order system is used, as shown in Figs. 1, 2, 3 and 4, showing the back and front of each of the two cards on which these shop orders are issued. Figs. 1 and 2 show the general shop order form used for all work which cannot be directly charged to some individual car. Under this heading is placed the

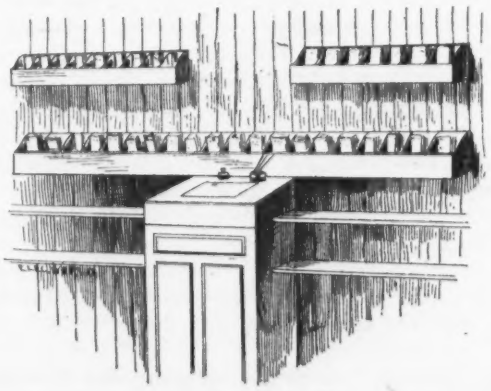


FIG. 6.

manufacture of stock prior to using and the repair of sundry small parts of the equipment, such as cleaning and rethreading of bolts when such work is permitted to collect until a sufficiently large quantity is gathered to keep a man busy for several

hours. All work not chargeable to repairs of rolling stock is also provided for by these order cards. Figs. 3 and 4 show the front and back of the form used for all repair work which can be charged to individual car numbers. Both of these forms are printed on white and pink stiff paper. The white forms are the original orders issued from the office directly to the foreman to whom the work called for by the order is assigned. In the upper left-hand corner of each white form there is a serial or separate number. The pink forms are used by the foreman receiving the original as a sub-order for work needed in other departments of the shop, and are marked by them with the same serial number and order or car number as the original, while the "nature of work" required is described by him under that heading. Upon receiving the original order the foreman assigns the work to his men, and puts the time expended by them on time slips, shown in Fig. 5. These time slips are turned in to the foreman at the end of each job or each day, and are p'aced in the same department of a rack (Fig. 6) with the original or sub-order on which the work was done, after having been inspected and approved by him. When a workman requires material for his work he carries the order slip on which he is working

Order on General Storekeeper for Material.

6/20 1896

Please deliver to Bearer the following:

G.E. 800 Arm. Bearings	2	
lbs Waste	2	
Controller Tips	7	
21c Shoes Brill	4	
" " Keys	2	ctd

Purpose Required: F. H. Shaw.

FIG. 7.

to his foreman or the inspector who has the supervision of the job, and receives from him either a pink sub-order, if the part removed can be repaired, or an order on the stock room, shown in Fig. 7, if he requires new material. Each department keeps a stock of such parts as fall to it for repairs. The workman on receiving his order goes either to the department on which his sub-order is drawn, or to the stock room with his requisition, and presents both requisition and order card upon which he is working. When giving out the material the stock-room clerk or the foreman of the department enters on the back of the order slip (Figs. 2 and 4) the material delivered, in black ink if it is new material, or in red ink if it is an old piece repaired. Each foreman enters the time cards each day in his time book, an abbreviated page of which is shown in Fig. 8. This book shows in the columns so marked underneath the name of each man, the order number on which he worked, the hours employed and the amount due him each day. Under the columns headed "Distribution," the amounts due to the individual workmen are collected under the proper charges for submitting to the auditor with the pay rolls. The amounts due the individual men each day are summed up in the column headed "Grand Total." and this must, of course, check with the sum of the amounts charged in the various columns of the distribution for that day. Upon the completion of any order the foreman to whom the original was issued collects the time cards belonging with it, and sends them attached to the order slip to the shop clerk, who sums them up, marks the amounts opposite the proper headings in the place provided on the right end of the card, as shown in Fig. 3, and enters the cost of material on the back in black ink. The cost of any material entered in red ink is not included, as the cost of repairing it will appear on the pink slip issued by the foreman, who received the original order, and will be entered from that slip. The order slips go from the shop clerk to the entering clerk, the time cards being filed away in boxes marked with the dates of the cards contained in them for future reference. The entering clerk enters all orders not charged to individual car numbers on a

	NAME	RATE	CAR	HRS	Jackson	Edwards	Williams	TOTALS	REPS CARS	DISTRIBUTION E.E.	" BLDGS	" LINE	TRACK	POWER HOUSE	C.T. CAR SERVICE
SUNDAY	PIECEWORK		135	6	159	159	124	442	74	368					
	DAY														
MONDAY	PIECEWORK														
	DAY														
TUESDAY	PIECEWORK														
	DAY														
WEDNESDAY	PIECEWORK														
	DAY														

FIG. 8.

blank, labor and material being placed together, and then files away the order slips for reference in the order of their numbers, placing the blank sub-orders with the originals as they come in. Each original order shows under the head "Sub-orders 2" the sub-orders issued upon it, and when these are all in the order is closed and so marked in a blank book, in which a record is kept of the orders as they are issued. So much for work not directly chargeable to individual cars. These orders are completed, filed and will at any time show the exact cost of any piece of work, its date and nature, also the names of the workmen employed on it.

The orders charged to individual cars (each car number is a standing order for work on that car), made out on forms shown in Figs. 3 and 4, are entered by the entry clerk on a form such as is shown in Fig. 9, the columns of which correspond to the headings and subheadings printed on the right end of Fig. 3. Accounts are not kept with each individual car, but with each class of equipment, as, for instance, on Westinghouse motors and Peckham trucks carrying 18-foot Laclede box cars, or G. E.-800 motors on Brill trucks carrying Brill 18-foot box cars. These accounts on forms such as Fig. 9 are

	ELECTRICAL MAINTENANCE						MAINTENANCE OF TRUCK				MAINTENANCE OF BODY				ACCIDENT	IMPROVEMENT	
	CONTROLLERS	ARM. & FIELD	BRUSHES	WIRING, GREASING, INSPECTING	BEARINGS	TROLLEYS	MISC.	BRAKES	JOURNALS	WHEELS	MISC.	SAND BOX	GLASS	FENDERS	MISC.	ACCT.	DESCRIPTION	AMOUNT

FIG. 9.

footed up each month and to them are added the cost of any order numbers chargeable to them as shown in Fig. 9.

The car cards, Figs. 3 and 4, after being entered are pasted in the leaves of a cloth stub and put into the rack in large, stiff envelopes, as shown in Fig. 10, each marked with a car number. After thus being filed they form a complete record of the work done on any car, also the date of putting in service and the removal of any article

used on that car. This completes the record of the work done at the main repair shop.

Now comes the accounting for work done by the shed crews. This is arranged for as follows: As before mentioned, small articles when disabled are sent to the repair shop for attention. In fact, all articles removed from cars at the sheds are sent to the shop, each being tagged with the number of the car from which it was taken. Each article thus tagged, on arriving at the shop, constitutes a requisition for a similar part to replace it, which part is immediately sent back to the division shed by the foreman of motor repairs, who receives all such articles and enters in a blank book the name of the division and the article, the car number it was taken from, date and number of the car to which it was returned. Upon the receipt of each article a pink slip (Figs. 3 and 4) is issued on the proper car number by the foreman of motor repairs for either the repair or replacing of the part received.

In addition to this system of returning broken parts, sheet forms as shown in Figs. 13 and 14 are issued to the shed crews, on which they record the use of waste, oil, grease, brushes, etc., which cannot well be returned. These forms are turned in to the shop clerk on the 1st and 15th of each month together with the time cards of the shed men, and one card (Fig. 5) on which the total labor of the shed force for each sub-division is entered opposite its appropriate heading.

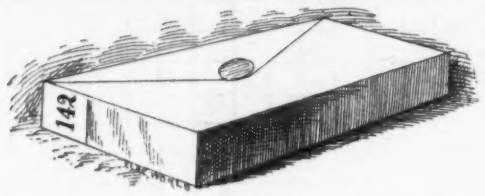


Fig. 10.

These material forms and time cards are summed up for all the sheds and their amounts distributed to all cars alike, the amounts being entered on form Fig. 9, in red ink opposite each class of equipment in proportion to the number of cars it contains. The cards issued for the repair or replacing of material received from the division sheds are of course filed in the same envelopes with the rest, but are distinguished from them by bearing the number of the standing order as well as the car number to which they belong.

To make the system of shop orders clearer it may be well to give an example which will serve to show at the same time the method used in recording piece work. For instance, suppose that open car No. 135 is received at the shop for repairs; an order, Figs. 3 and 4 is drawn, marked "Work on truck of open car No. 135, received 6/20, 1896. Name of workmen, Jackson, Edwards, Williams." The foreman of motor repairs assign the car to pit gang No. 3, consisting of say two men and a boy, and gives the order card to the gang leader. The inspector under whom gang No. 3 works immediately looks over the car and finding that it needs an armature replaced, both motors and controllers cleaned, a set of brake shoes, a turnbuckle rod re-threaded, etc., he writes on the face of the original order under the heading "Nature of work," the numbers of the jobs to be done as shown in his piece work price list and makes at the same time a duplicate entry in his note book under the number of the car and the date, and enters the names of the men composing gang 3, where the space is so marked on the card. Having entered the numbers of the piece work operations, the inspector proceeds to make out first a pink sub-order on the winding room to repair the armature No. —, then a similar sub-order on the machine shop for the damaged turn-buckle rod, and finally a requisition slip on the stock room for a set of brake shoes, some waste, a few odd bolts, etc. On removing the condemned parts from the car, the gang leader sends his apprentice with them to the department or stock room where he is to draw others to replace them. The apprentice takes with him the original order form, and the sub-orders. Upon receiving his material it is entered upon the back of his original order. When the work is completed, the inspector signs and dates the original order at the bottom, and checking it against his note book turns it in to the foreman, who enters it in his time book, crediting each man with his due proportion of the work.

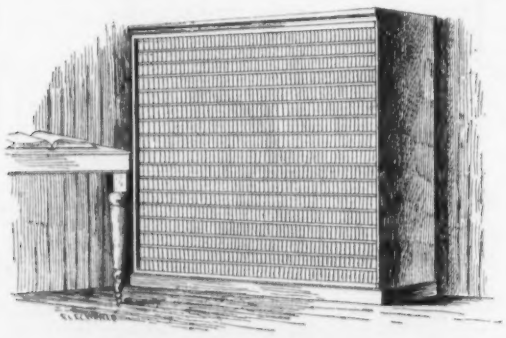
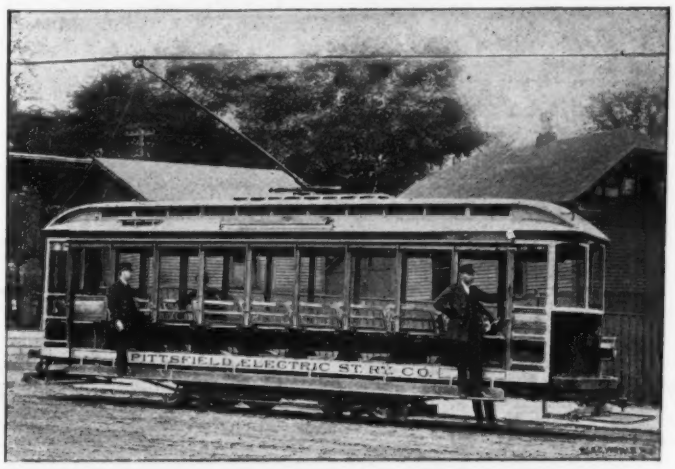


Fig. 11.

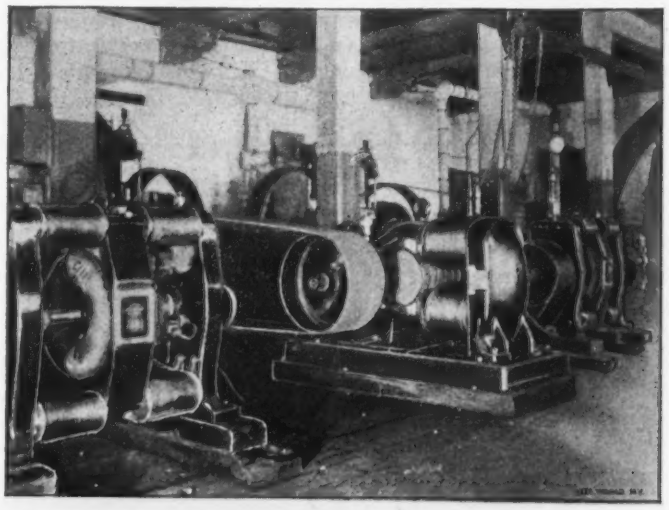
A great point in the system such as the one described is that it avoids the labor of copying almost entirely, with the exception of the entries in the time book, and in the form, Fig. 9, there is no copying. These are only necessary in order to sum up the separate amounts and may far be made a matter of permanent record for reference than entered upon loose sheets and then thrown into the waste basket.

The Pittsfield (Mass.) Electric Street Railway.

Most of the operating equipment of the Pittsfield, Mass., electric street railway is of the old pioneer type, but recent additions of the most modern apparatus makes the system one worthy of description. The company obtains its power from the Pittsfield Electric Company, the equipment for which consists of three generators operating at a pressure of 570 volts. Two of the generators are of the horizontal United States type. Each machine is rated at 40 kilowatts, and runs at 550 revolutions per minute. They are belted to Westinghouse compound engine, running at 300 revolutions per minute and operated at a pressure of 100 pounds. The third generator is of the latest type of Westinghouse machine, and also runs at 550 revolutions, has six poles, and is rated at 150 kilowatts. It is driven through an intermediate jack shaft. The machine is built without pole shoes, the shunt and series coils being held on spools belted to the upper part of the field magnet. Six brushes are used, and are operated by a worm, bevel gears and a hand wheel, making a simple and powerful mechanism for the purpose,



Vestibule Car.

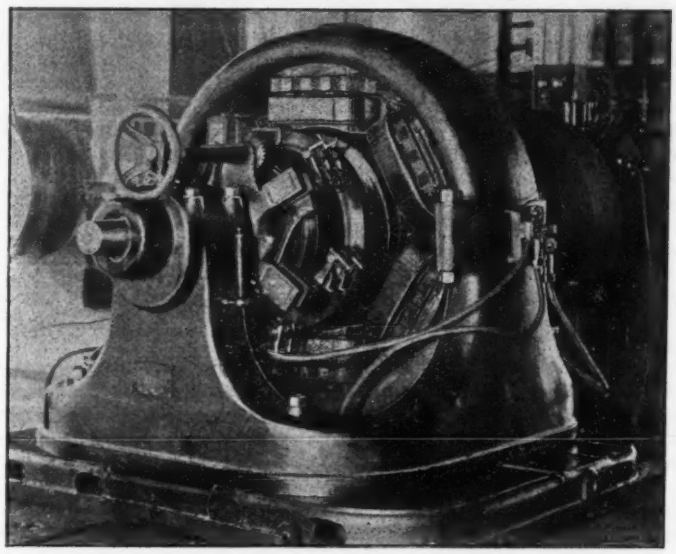


Horizontal Generators.

The bearings, which are of course self-oiling, are appointed with a little gauge by which the amount of oil in the oil well can be readily ascertained. The machine rests on a movable base, and is provided with the customary belt tighteners. All the machines are operated in multiple by means of equalizers. A new switchboard is being installed. In spite of the recent addition of this new generator the station is considerably overloaded, which, however, the machines stand remarkably well. Upon the six-pole generator being accidentally short-circuited, the only perceptible effect was the excessive screeching of the belt as it slipped on the pulley, there being no fireworks display at the commutator.

The track is mostly laid with a T rail, a girder rail, however, being used in a few places in the centre of the city. The rails are bonded with double Chicago bonds, and no difficulty is experienced due to electrolytic action. There are four overhead feeders, which branch about the city feeding those places where the load is heaviest. No. 00 trolley wire is used.

The overhead construction is supported by steel poles in the centre



RAILWAY GENERATOR.

of the city and by wooden poles on the outskirts. The road is about nine and one half miles long and single with the exception of turnouts. The rolling stock is representative of both old and new types and consists of 12 cars, the newest types being made by the Brill Company. As will be seen from the illustration, the compartment for the motorman is somewhat new. It gives him plenty of room and yet does not occupy the whole of the front platform, the space on either side being available for seats. This arrangement is worthy of notice. The cars are electrically lighted and have electric headlights. The trucks are mostly of the Bemis type, made by the Bemis Car Box Company, Springfield, Mass. It will be noted that the car is vestibuled, which is also a new departure in electric cars. The electrical car equipment is all Westinghouse. Ten of the twelve cars each have two 30-hp motors and the remaining two 40 horse-power. The controllers are of the Westinghouse type and on the new cars are of the latest design. The equipments have given very satisfactory service.

Powers Over Street Railways.

BY R. D. FISHER.

In the pending litigation throughout the country, where differences have arisen between municipalities and street railway companies, the modern charters granted to many cities by State Legislatures are expected to have an important bearing upon street railway interests. Much of the law establishing precedents was enacted or made by rulings previous to the adoption of what are termed the "modern charter," and, as is well known, the latter contemplates an entire change of the powers of municipalities through their officials. The modern city charter, experimental in nature, has been tried and generally proven a success. Their central features, as a rule, consists of an absolute separation of the executive, legislative and judicial powers in the city government, which necessarily involves a large increase of powers in the executive department. Another important feature of the modern charter is the provisions under which a municipality may improve its streets, which also, as a rule, involves a grant of almost absolute power over the streets to a board of public works.

Very few street railway charters antedate 1860, and the law then in vogue and much of it subsequently enacted was made with a view to particular cities and under singular circumstances. A number of the modern charters empower the board of public works, "to lay out, open, change, vacate and to fix or change the grade of any street, alley or public place within such city, etc." Further, "to license the digging of any hole or the removal of any material from the surface, or underneath the surface of any street, alley or public place in such city; to require bonds for damages and for the proper replacement of the street, and to refuse such licenses when the public interest requires it. To direct the removal of any or all structures in the streets, alleys or public places of such city, and to remove the same at the expense of the persons maintaining the same on their failure to make such removal." These charters are nearly counterparts, and as acts of the respective Legislatures provide that, "all laws within the purview of this or these acts and inconsistent herewith are repealed."

Thus it appears, from the wording of the so-called modern charter, that it would seem quite plain the Legislatures intended the power of a board of public works to be superior to any contract rights of any body in the streets. If the board wants to vacate a street upon which tracks of a street railway are laid the company's objection to such vacation, on the ground of a vested interest, would not avail, because the implied theory of the law is that the city can merely "consent" that the company occupy a street. A city makes no guaranty that there shall always be a street, and even if it were construed to do so the provisions of the modern charter gives the board the right to vacate "any street," and repeal any law inconsistent with that power. Again, these charters give the board power as to any digging in a street or removing materials therefrom, "to refuse such licenses when the public interest requires it." Is it not the evident meaning of such language to make boards of public works the exclusive judge of what "the public interest requires," and to make its decision binding? If this is the law and shall be so construed by the courts in the several interesting causes now pending in the highest court of the land, street railway companies may be ousted by the vacation of a street, or estopped to lay additional track, extend their lines or improve those already down by digging, removal of material from the surface or otherwise occupy the streets for such purpose by withholding licenses "when the public interest requires it." If the law under these charters be not so construed it is not improbable that many street railway companies under implied power of the words used in the law under which they were chartered and given franchises would be enabled by right to enter upon and lay tracks and conduct passenger traffic upon any street, improved or unimproved, within a city which had originally granted it franchise rights. This view of the law can scarcely be hoped for in the causes now pending. The various Legislatures had in view the rapid and permanent improvement of the streets with modern and expensive material, and it is highly probable that the higher courts will hold that cities may be able to protect such improved streets for use and enjoyment, free from despoilation or annoyance of street railway traffic. Numerous attempts have been made recently under such circumstances to improve and extend street railways in cities operating under recently granted charters and have been enjoined to further prosecute the work pending a final construction of the provisions of the charters under which the injunctions are claimed to rest. There is a crying need for a simplification of street railway law. There should exist a better feeling between municipal authorities and capitalists who invest money in street railways—the best, most accommodating and useful industry of a growing city, and one calculated to extend its borders and bring the rural or suburban districts in close touch with the city proper. The decisions now pending involving the life of franchises and the powers over streets, and several other equally important questions, will be awaited with interest and concern by both capitalist and municipal authority.

Annealing of Iron and Steel.

Messrs. Ebeling and Schmidt, in *Wiedemann's Annalen*, No. 6, state that annealing iron and steel is not always beneficial. If the annealing itself is uniform, it is profitable. The most uniform results are to be obtained by careful fusion.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Practical Significance of the Power Factor. Lond. *Elec. Rev.*, July 3.—A brief editorial description of the power factor and its importance in connection with motor circuits, but containing nothing new; a low power factor of an induction motor is not thought to be so serious a drawback as first appears.

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Alternate-Current Motor. DAVIES system. *Elec. Eng.*, July 15.—A abstract of the descriptive article with the illustrations, which was abstracted in the *Digest*, July 11.

Test on Large Polyphase Transformers. KORDA. *Elec. Eng.*, July 15.—A reprint with the illustrations of the article abstracted in the *Digest*, July 18.

LIGHTS AND LIGHTING.

Negative Resistance. S. P. THOMPSON, Lond. *Elec.*, July 3; a reprint in full with the discussion in abstract of a Physical Society paper on the "Properties of a Body Having a Negative Electrical Resistance."—He refers to the paper recently read by Messrs. Frith and Rodgers on the electric arc (see *Digest*, June 6) in which the conclusion is drawn that the true resistance of the arc may under certain circumstances be a negative quantity; the admissibility of this view is open to question; he considers the properties of a body having such a resistance if it could exist. There are two ways of defining resistance, one of them according to Ohm's law and the other as a measure of the amount of energy degraded into heat according to Joule's law, both of which he discusses; to attribute a negative sign to the resistance in these laws would have the effect of causing a positive E. M. F. to produce a negative current, or if a current is forced in either sense through a negative resistance there should be a rise instead of a fall of potential, or according to Joule's law the current would cool instead of heat the resistance; the logical issues of the effective and negative resistance are also discussed; beginning with a large positive resistance let it be supposed to diminish to zero and then change sign and become negative; under the action of a constant E. M. F. the current will then at first be small and positive, then increase and become infinitely great and at once change to an infinitely great negative one, which will then gradually diminish. A counter E. M. F. acts as a positive resistance, producing a drop of potential, which, however, does not increase with the current; electrical tests afford no criterion to discriminate between constant resistance and a counter E. M. F. that is directly proportional to the current; resistance is usually uniformly distributed, while a counter E. M. F. is local when caused by chemical effects and is distributed, though not uniformly when due to induction, while thermo E. M. Fs. are in some cases local and in other cases distributive; hence no criterion as to whether a drop of potential is due to a counter E. M. F. or to a resistance is afforded by the nature of the drop, that is, whether local or distributive; in a circuit containing an equal positive and negative resistance the smallest E. M. F. would result in an indefinitely great current, warming one, however, and cooling the other. Electrical tests afford no criterion to discriminate between a constant counter E. M. F. and a resistance which varies as the current. The phenomena of thermo-electricity are also discussed; while at first there might appear to be a negative resistance in one of the junctions, a reversal of the current shows that there is not and the apparent resistance must therefore be recognized as due to E. M. Fs. Referring to the observations of Frith and Rodgers, he states that they found something which acts like a negative resistance and which is approximately inversely proportional to the current; unless there is some other test available their measurements afford no criterion as to whether this is a negative resistance or simply an adjuvant E. M. F.; it is impossible in this case to reverse the current and there is no evidence as to whether the effect is local or distributed; they have defined resistance neither according to Ohm's nor Joule's law, but as the ratio of the increment of the voltage across the arc to the increment which is given to the current; their results show what they have measured is not independent of the current, from which it follows that this quantity is not the resistance as hitherto defined but means something else; all that their observations prove is that that part of the resistance which is not constant is a positive resistance which varies inversely as the current; that the resistance of the arc should vary inversely as the current is most natural.

In the discussion Prof. Ayrton stated that what Frith and Rodgers maintained was that if the arc acts as if it had a back E. M. F. and a resistance, then the resistance is a negative quantity; if a loss is proportional to the square of the current the circuit has a resistance, but if it is proportional to the first power of the current there exists a back E. M. F.; he doubts whether it is possible to imagine a circuit in which a loss of energy occurs proportional to the current, and a return of energy to the circuit proportional to the square of the current; he thinks the author has based his paper on three misconceptions: First, that it has been claimed that negative resistance could exist alone; second, that the curve given by Frith and Rodgers showed that the ordinates were directly proportional to the current; third, that what was measured was the geometrical relations between the increments of the voltage and the current. Mr. Frith stated that in their paper they had defined the resistance of the arc as this ratio, by which they meant not what was ordinarily understood by this expression, but the value of the ratio obtained by superposing an alternating current on a direct-current arc; experiments were carried out to show that this gives the correct results for the resistance; he also exhibited a mechanical model, which shows one of the questions involved. Prof. Thompson in his reply stated that he disputed the interpretation which those authors had given to their results, but he did not question the accuracy of the results themselves; the question is, is there anything in the arc which acts as a source of energy? Frith's experiments give no hint as to the point where the negative resistance occurs, and the absence of any such energy-giving portion is rendered probable by the fact that the arc itself is hotter than the crater.

The subject is further discussed by Profs. Ayrton and Thompson in a communication to that journal; Prof. Ayrton thinks that Thompson's arguments are inclusive; the last argument that a negative resistance would require the arc to be cooler than the carbons, whereas it is known that the arc is hotter than the crater; he refers to some results obtained by Mrs. Ayrton with a very thin exploring carbon in which she found that in an unconfined arc the rod remained rigid when in the arc but softened enough to bend when touched against the positive crater; the temperature of the arc increases with the current when the arc is enclosed, as in a furnace; and even if the arc were hotter than the carbons it would not show the character of the resistance of the complete arc; Mrs. Ayrton had also predicted some time ago, and proved it experimentally, that what Frith called the geometrical relation between the increments of the voltage and the current between cored carbons differs in sign from the electrical ratio of these increments; the geometrical relation means the ordinary differential coefficient of the function which gives the steady value of the voltage in terms of the current, whereas by the electrical ratio Frith means that which exists between a small alternating voltage and a small alternating current produced when it is impressed on the ordinary direct-current arc. He quotes from a letter of Mrs. Ayrton's three years ago, referring to experiments with a cored positive and a solid negative, and suggesting a theory for the sudden drop in volts for an increase of current; when the current was increased the conducting medium at the first moment is only that which conveys the original current and therefore has too great a resistance for the new current; this causes a small rise at first and a greater heating of the positive carbon, which then volatilizes more abundantly, creating a greater flow of the conducting medium than was necessary, and this then falls to its normal value when the voltage also becomes normal; every time the current is changed from a lower to a higher value this first small rise in potential is produced; a second proof is that when the current is increased the negative carbon suddenly grows bright and larger, after which it gradually decreases again. Prof. Thompson in his reply stated that Prof. Ayrton missed the last point, which he explains again; he had been under the impression that Frith's experiments had been with a continuous-current arc, but it now appears that an alternating current had been impressed on the continuous, and it is of importance therefore to know what was cause and what was effect; he discusses the difference between the two relations of voltage to the current, and he thinks it evident that negative values show that the thing which is measured is not resistance. Editorially it is suggested that the observations of Mrs. Ayrton might be explained by the overheating of the negative carbon, which would diminish greatly the difference of temperature between the two carbons which would diminish the back E. M. F. due to thermo-electric causes.

The subject is also discussed in the leading editorial, in which it is admitted that an adjuvant distributed E. M. F. is physically possible and that a distributed E. M. F. is fundamentally the same thing as resistance, from which there is only one possible inference, namely, the absolute identity of the negative electrical resistance and adjuvant distributed E. M. F., and since the latter is possible and actually occurs, so may the

former also; induction in a coil might at first give the impression of a negative resistance; it is thought that the true explanation of the behavior of the alternating arc will be found in some theory which involves a radical change in our ideas; the conclusions of Messrs. Ayrton and Frith are not finally accepted; it is thought that they are not inherently impossible, but on the contrary they seem to possess a high degree of probability.

Ammeters in Arc Light Circuits. DESMOND. *West. Elec.*, July 18.—An article under the heading "Voltmeters and Potential Indicators," in which he shows that it has generally been thought unnecessary to use an indicating instrument in arc light circuits corresponding to the voltmeter and potential indicators in connection with the incandescent light circuits, the reason being that reliance was placed on the automatic apparatus; automatic regulation is satisfactory as long as the apparatus is kept in proper order and the lamps are clean and working freely, but he believes there is scarcely one arc lamp circuit in ten where the lamps are giving full candle-power or burning steadily, owing to too great reliance in the automatic regulating device; the candle-power will fall very greatly with an insufficiency of the current; the regulating apparatus indicates certain changes while in use generally resulting in a reduction of the current, which in turn affects the working of the lamps to a noticeable extent, much of the hissing and flickering being due to this cause; there are scarcely more than 50 per cent. of the arc lamps in use "in the city" (Chicago?) that are giving as much as 75 per cent. of the amount of light which might be obtained at a very slight increase of the power, making it equal to that intended by the designer; there is no economy in trying to obtain light by cutting down the current, which latter should be kept at the standard amount, to ensure which a more sensitive apparatus is required than the ordinary automatic regulator; such an ammeter should have about the same degree of sensitiveness that the ordinary potential indicator has for incandescent circuits; it should show plainly the variation of one tenth of an ampere, and it will then greatly assist in overcoming the troubles from hissing, flickering and flaming lamps, and a general reduction in their candle-power, and will greatly improve the amount of light obtained per lamp.

Electric Lighting of Railway Trains. *Elec. Rev.*, July 15.—A brief description, by the Consul-General, of the system used on an express train in South Australia. Accumulators are charged by a dynamo in the brake van, the power being derived from the axle after the train has attained a speed of 25 miles per hour, there being an automatic governor to couple the dynamos with the batteries; the dynamo has a capacity of 80 amperes at 65 volts; the battery consists of 24 cells with a capacity of 550 ampere-hours and they are all on the brake van; there is an automatic apparatus to regulate the voltage, no description of which is given; ordinarily a charge will be sufficient for two or three trips of 280 miles each; when it is necessary to charge the cells a special attendant is sent out with the train; on one train there are 25 lamps of 10 candle-power and 34 of 5 candle-power as a maximum; the cost of installing the plant on one train is $3845, and the cost of maintenance per week (apparently not including the power) $17.93, while previously the cost of lighting with kerosene was $19.46.

Electric Light in Mining Operations. BAXTER. *Elec. Rev.*, July 15.—A reprint of an article abstracted in the *Digest*, July 18.

Public Arc Lighting on Motor-Generator and Converter Systems. *Elec. Eng.*, July 15.—A reprint from the Lond. *Elec. Rev.*, of the short editorial article abstracted in the *Digest*, July 11.

POWER AND HEAT.

Electric Fire Pump. *L'Energie Elec.*, June 16.—A brief, illustrated description of one made in France, consisting simply of an electric motor driving a two-cylinder pump by means of a worm wheel, the whole being mounted on two wheels and arranged to be drawn by a man; it is intended for use in cities provided with electric mains; its use is also suggested for watering parks, pumping out mines, agricultural operations, etc.; it is arranged so that the pump can readily be disconnected, thus permitting the motor to be used for any desired purpose.

Traveling Platform for Railway Work. Lond. *Elec. Eng.*, July 3.—A brief, illustrated description of one used by a French Government railway.

Transmission of Power at Rheinfelden. RATHENAU. *Elek. Zeit.*, July 2.—A very long illustrated description of this plant near the City of Bale, Switzerland, in which the water-power of the Rhine is used; the description includes a lengthy discussion of the relative advantages of different systems. For lighting in the immediate neighborhood a direct current is used in connection with accumulators; for the power transmission to a distance the three-phase current is used; the frequency is 50; an area of about 12 miles in radius is to be supplied with power; the most economical voltage would have been 16,500, but for the present 6800 will be used, which will afterward be doubled; the three-phase machine is well illustrated and is of the horizontal type, all the coils being stationary and only the pole-pieces moving; the normal output of each dynamo is 63 amperes at 3800 volts per phase, therefore corresponding to 720 kilowatts; the lighting and the power circuits are independent of each other, 4 generators being used for the former and 14 for the latter, half of which will be used for chemical purposes; the direct current is obtained from three transformers of 150 horse-power each; the alternating current transformers consist of three cores with a common yoke piece and all in one plane; the primary lines are of bare copper run overhead, 11 metres high; there are lightning arresters every 500 metres; where they pass over roads or railways a guard made of a net of wires, is stretched underneath them; with a current density of 0.9 amperes per sq. mm on the primary circuit the sum of the losses in the generators, line, transformers, and secondary network, is 18 per cent., representing an efficiency from the turbine shaft to the lamp, of 72 per cent.; with the four-light generators 35,000 lamps of 16 candle-power can be supplied; for the transmission of power at 16,500 volts, the efficiency from the turbine shaft to the motor pulley is 65 per cent. The charge for lighting will be 10 cents per kw-hour, with rebates amounting up to 80 per cent.; for power purposes the price is 0.4 cents per kw-hour, not including a tax which is paid at the start.

TRACTION.

Heilmann Locomotive. DROUIN. *L'Elec.*, July 4.—A brief extract from a recent paper read before the Society of Civil Engineers of France. The two new machines which are at present under construction differ from the first one in an increase of power over the steam engines, the later ones developing 1,350 indicated horse-power; the motors are supported in a different way; a Willans & Robinson engine is used; the controlling apparatus has been modified; an ordinary locomotive type of boiler is used. Like in the first locomotive the steam engine has a constant admission of steam and runs at a variable speed; it drives directly two generators of 450 volts, which are separately excited by a small steam engine; the motors are connected with the axes by an elastic coupling; the locomotive is to develop 1000 horse-power at the wheels; the efficiency on a level and at a speed of 60 miles is a little less than 50 per cent., which represents the ratio of available power at the draw-bar to that indicated in the cylinders; the ratio of the effective work at the wheels to that indicated in the cylinder is 75 per cent. and is appreciably constant between wide limits of speed; they will be able to draw a weight of 350 tons at a speed of 60 miles an hour on the level. In the discussion Mr. Hart stated that this new machine would weigh 220 pounds per horse-power, while some of the later forms of steam locomotives weigh only 35 pounds per horse-power; it is expected that the locomotives will be running at the end of August.

Underground Railway in Budapest. *Elec. Tech.*, June 30.—The railway was opened May 2; besides giving some of the civil engineering features, it is stated that there are 20 motor cars and 10 trailers; they are 12 metres long, 2.2 metres broad and will seat 28 passengers; the maximum speed is 24 miles an hour; the total cost of this railway was nearly $1,500,000.

Electric Traction. MOORE. Lond. *Elec. Eng.*, July 3.—A Municipal Electrical Association paper of a general nature, considering the question from a civil engineer's standpoint, and consisting chiefly of brief descriptions of the electrical railways in England.

Direct-Coupled Generator at the Stockwell Power Station. Lond. *Elec.*, July 3.—A brief, illustrated description of the generator at this station, which is one of those supplying the City & South London Underground Railway.

Proposed Electric Traction Scheme in Berlin. KALLMANN. Lond. *Elec*, July 3.—A brief abstract of the article noticed in the *Digest*, June 27.

Surface Contact System. Lond. *Elec. Rev.*, July 3.—An illustrated description of the Pringle and Kent system, noticed in the *Digest* last week.

Storage Battery Auxiliaries for Railway Power Stations. WILLIAMS. *Wisconsin Engineer*, June.—After discussing the storage battery question in general, and showing why it is used so little in this country, he points out the great importance of a regulator in street railway work, and discusses the question of whether it can be satisfactorily met by accumulators; he shows that they can stand rapid discharges by citing several cases showing what they are doing in practice, and concludes that the batteries, as now made, are fully as reliable as any of the generating apparatus of a power station; he gives two diagrams of the Merrill station, showing the voltage with and without accumulators. The question must be decided therefore by the economy of operation; he gives the data of a number of stations, showing the advantages of running the engines at their full load; a station with one third or one half of its power equipment in accumulators, allowing the engines to be worked at their best load, would save nearly six pounds of steam per hp-hour, which for a 30-car line would be a saving of about three tons a day; in fair-sized plants a horse-power of accumulators can be installed for the same cost as a horse-power of steam; the former rapid depreciation of accumulators is no longer one of the great objections to their use; as an example of the economy of a combined station for railways he gives the results of the plant at Zurich. Tables are given showing the equipment of power-stations in small American cities, the average of which is 25 indicated horse-power of engines to each car and about 19 kilowatts of generators; he considers it safe to assume that the average

station operating 12 to 30 cars would not develop more than an average of 15 indicated horse-power per car. To show the economy of a combined steam and storage-power station he gives estimates of the first cost and operating expenses of two stations of different sizes for each method; the estimates for the larger plant show a decided economy in favor of the combined plant, but for the small plant the cost of the accumulators and the fact that the engines cannot work at their best load, neutralize the gains otherwise made, and there is therefore no economy over steam. He concludes that for medium-sized new plants or remodeled and enlarged old ones, whenever more than 15 cars are to be provided for, it will probably be economy to put in about half the power in accumulators; there would probably be no economy in using storage batteries in large stations where the load is practically constant; a battery plant in a 30-car station would pay for itself in coal savings, in 10 years where coal is $3, and 16 years where it is $2; many small plants could be driven from available water powers by using batteries; the present cost of accumulators is one of the greatest hindrances to their more extended use.

Dayton-Miamisburg R. R. Elec. Eng., July 15.—A brief, illustrated description of the "fast line" connecting these two cities in Ohio, the distance being 12.5 miles; illustrations of the power house, car barns and cars are given, the latter being like standard steam railroad cars 35 feet long and mounted on double trucks, the motor cars being equipped with two 50-hp motors.

Efficiency of Compressed Air in Street Car Motors. Lundell. *Elec. Eng.*, July 15.—A short reply to the criticisms of Haupt (see *Digest* last week) to the general effect that the latter had completely failed to understand the original article.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central-Station Statistics. Elek. Zeit., July 2.—A continuation of the table noticed in the *Digest* last week and consisting of 19 full page tables giving information for 36 of the more prominent stations, chiefly in Germany, including a few of the larger ones in the neighboring countries on the Continent; the table appears to be much more complete than those usually published and contains a large amount of matter regarding the operation; it refers to the years 1894–95. The increase in the connections made with the stations is in some cases 100 per cent. and in a number of stations the importance of providing for future extension is shown; of the 36 stations 18 are municipal and 18 belong to companies; the charge, depending on the amount of current, varies from 9 to 24 cents per kilowatt-hour for lighting purposes and 4.5 to 10 for power purposes; the reductions due to quantity vary very greatly and in some cases the time during which the current is used is considered; the table shows the important part taken by the accumulators; on an average the ratio between the outputs of the machines and the accumulators is as 124 to 119, which it is editorially thought will soon change in favor of accumulators as their price has been appreciably diminished while the price of machines has risen somewhat. The weight of copper per kilowatt averages 220 pounds; for multiphase currents it averaged 94.6 pounds; the average consumption amounts to 0.04 kilowatt per metre of house frontage; an average of 0.27 kilowatt-hours of energy delivered by the station is obtained for every kilogram of coal; compared with the previous year the output of 18 of these stations increased 43 per cent.; each lamp was connected for an average of 400 hours a year; the maximum number of lamps averaged 46 per cent. of those connected; for the continuous-current stations with accumulators the loss of energy averages 22.33 per cent.

Graz. Pojatzi. *Zeit. f. Elek.*, July 1.—An illustrated description of some length of this station; a direct-current three-wire system is used, the voltage being 150 at the lamps; in addition to the central station, which is some distance off from the centre of the city, there is an accumulator sub-station in the middle of the city which is charged during the hours of light load, the increased voltage for this being obtained by increasing the speed of the generator; the distance to the accumulator station is little less than a mile.

Private Plant. Elec. Eng., July 15.—A brief illustrated description of the lighting plant in the Metropolitan Life Insurance Building, New York.

WIRES, WIRING AND CONDUITS.

Electric Light Mains. Lond. *Elec. Eng.*, July 3; a brief interview with Feldmann, chief electrician of the Helios Company.—His method of laying out a new town is roughly as follows: The main and side streets are selected and marked on a convenient scale together with the probable consumption based on the previous consumption of gas and on the customs of the people; complete rings of mains are then plotted for the supposed load, after which the distribution in the various branches is tested by calculation; the section of the main is chosen according to experience and changed if the distribution found requires it. He is opposed to the practice of using a low-pressure network with alternating-current distribution, even though the load losses in the transformers are higher; the low-pressure distribution system costs more; the good regulation of the high-pressure distribution is nullified in the low-pressure mains; with good transformers the cost of magnetizing is more than counterbalanced by the interest charges and depreciation on the low-pressure system; the risk of interference with telephone circuits is largely increased by using a secondary network.

Distributor. Lond. Elec., Elec. Rev. and *Elec. Eng.*, July 3.—A brief, illustrated description of the Wordingham pillar distributor for connecting up underground wires, the object being to provide for rapidly disconnecting at the linking points of a network of wires, to facilitate localizing faults; each wire is capped with an eyelet, which is bolted to a ring carried by the support and insulated therefrom; in the form shown there are three such rings.

Rules and Regulations. Zeit. f. Elek, July 1.—A reprint of the rules for lighting and power circuits in Switzerland and Germany.

The Three-Wire Patent in England. Lond. *Elec.*, July 3.—The arguments for and against the issuing of an extension of the Hopkinson patent.

Subways for Electric Wires. Burton. *Wisconsin Engineer*, June.—A short article discussing in general the requirements of a subway system, and showing that it would be much better to keep the real objects and essential requirements in view, and not to give a conduit qualities which are of no practical value; he considers it a problem for the civil, rather than for the electrical engineer.

ELECTRO-PHYSICS AND MAGNETISM.

Hyperphosphorescence. S. P. Thompson. *Phil. Mag.*, July.—A short article referring to the recent researches of Becquerel on the emission of radiations from uranium, and to similar observations made by the author. In trying to diminish the exposure in taking the radiographs he used fluorescing substances in contact with the film, and tried numerous materials; when the rays were compelled to pass first through the fluorescing material, results were obtained tending to show that the method might have some advantages; care was taken to keep the materials in the dark for a long time previous to the experiment, but, nevertheless, though no visible phosphorescence was present, the films were foggy; fluorspar and the platino-cyanides did not produce any noticeable fogging, while sulphide of calcium was very active after being kept in darkness six weeks; other experiments are described, showing the photographic action of fluorescing material. The fact that the strongest fluorescing effects are found in the compounds of two metals having such heavy atomic weights as platinum and uranium, when correlated with the fact that the absorbing power increases with the atomic weight, suggests a new application of the law of reciprocity between emission and absorption, and if this law holds good the best substances employed as emitters would be those which absorb the radiations most freely; he mentions a large number of substances which emit Röntgen rays when exposed to cathode discharges; the relative transparency of flesh and bone differ when different materials are used as emitters indicating that the rays are heterogeneous; he considers it proved that Becquerel's rays differ from the known ultra-violet in degree rather than in kind, being waves of higher frequency and shorter wave-length; that their properties are intermediate between those of ultra-violet and of Röntgen rays furnishes a strong presumption that the latter differ only in degree and are extreme species of ultra-violet light. The phenomenon of persistence of emission of invisible rays by uranium compounds would seem to bear the same relation to the transient emission of them in the Crookes tube, as the persistent emission of visible light by phosphorescent bodies does to the transient emission of light by fluorescing bodies; hence he suggests the name hyperphosphorescence for this new phenomenon; a hyperphosphorescent body is one which after due stimulus exhibits a persistent emission of invisible rays not included in the hitherto recognized spectrum.

Transparency of Organic Tissue to X-Rays. Battelli. *Arch. d'Elec. Medicale*, June 15; abstracted briefly from an Italian journal.—By means of a photometric method he measured the specific (relative?) transparency of different tissues and the change of this transparency with variations of the thickness; from this it follows, in general, that organs are more transparent the less their density, thus the most transparent are the lungs, the adipose tissue and the marrow of the bone; cartilage has a relatively high transparency like the liver, the spleen and the heart, while compact bone is about twice as opaque as the latter; the transparency of the liquids of the body also depends on their density and it does not seem to be influenced by the quality of the substances in solution, provided the density is not changed; the transparency of tissue diminishes with the increase of its thickness, but the variation of the transparency is less rapid than that of the thickness; of the parts of the eye the lens is that which has the greatest opacity, while the other parts have a transparency very much like that of water.

Radiograph of an Infant. Imbert and Bertin-Sans. *Rev. Gen. des Sc.*, June 30.—A life-size reproduction of a radiograph of a newly born infant; the reproduction is better than those generally published and shows a number of interesting features.

Globular Spark. Righi. *Jour. Inst. Elec. Eng.*, June; an abstract of the recent article in *L'Eclairage Elec.*, noticed in the *Digest* some months ago.—A discharge from a large condenser may under suitable conditions produce a luminous effect near the positive electrode which increases in dimensions and travels at a comparatively slow rate toward the cathode, which it never reaches; sometimes there are several dis-

charges in succession; the author calls these globular discharges; the necessary condition is that the discharge circuit should have a very high resistance, which is effected by introducing a column of distilled water in the circuit; by using a large condenser and rarefying the gas, the dimensions of the spark and the distance through which it travels will be increased; the velocity of the luminous mass varies according to circumstances; the globular effect is seen only when it is viewed in a revolving mirror; with a velocity of one metre per second its movement is directly perceptible; to make the motion slower he used a very large condenser of 0.075 mf and consisting of 108 Leyden jars in series; the discharge phenomena occurred in the discharge tube containing a more or less rarefied gas; the duration of the phenomena may exceed one second. He also used another method for producing charges of still longer duration; with a high resistance in circuit he altered the distances between the two balls during the presence of a spark.

Edison Effect in Glow Lamps. FLEMING. *Phil. Mag.*, July.—A reprint, with illustrations, of his very long Physical Society paper on "A Further Examination of the Edison Effect in Glow Lamps," which was abstracted in the *Digest*, April 25.

Electric and Magnetic Research at Low Temperatures. FLEMING. Lond. *Elec.*, July 3.—The beginning of a reprint in full of the lecture which was recently abstracted in the *Digest*.

Magnetic Field Due to an Elliptical Current. JONES. *Phil. Mag.*, July.—A reprint in full of his Physical Society paper, noticed in the *Digest*, June 20.

Röntgen Ray Literature. Jour. Inst. Elec. Eng., June.—A large number of abstracts of papers which have been noticed in these columns, though in some cases more briefly.

Experiments on Röntgen Rays. PORTER. *Nature*; abstracted in the *Elec. Eng.*, July 15.—When a tube is strongly heated the rays are different and the relative transparency of flesh, bone, aluminum and glass differ for the two kinds; he therefore tried cooling the tube, which resulted in a greatly diminished fluorescence on the screen; as the tube gradually grew warm again the fluorescence returned very suddenly, reaching a maximum at about 12 degrees C.; from his experiments he finds that in some cases warming the tubes slightly might be useful for photographing the bones, while in others moderate cooling would be better; the particular method of heating or cooling is an important factor; the discharging effect of the rays from the heated and cooled tubes are described, as also the appearance of the tube; aluminum seems opaque to the rays emitted from a strongly heated tube; a lavender light appears on heating the tube, and gradually diminishes when it cools; when this is no longer seen, there is a whitish green fluorescence on the glass, which indicates the maximum point of the kind of rays due to the heated bulb.

Emission of New Radiations by Metallic Uranium. BECQUEREL. *El'ty*, July 15.—A translation of the paper abstracted in the *Digest*, July 4.

Invisible Radiations Emitted by Phosphorescent Bodies. BECQUEREL. *Elec. Rev.*, July 15.—A reprint of a translation of the article abstracted in the *Digest*, May 9.

Hyperphosphorescence. S. P. THOMPSON. *El'ty*, July 15.—A reprint of the article abstracted above.

Dark Light. LEBON. *Sc. Amer.*, July 18.—A translation in abstract of his paper which was abstracted in the *Digest* some months ago.

Electric Waves. COLE. *Phys. Rev.*, July-August.—A description of a method, including the results, used to determine the refractive index and reflecting power of water and alcohol for electric waves.

Viscosity of Polarized Dielectrics. DUFF. *Phys. Rev.*, July-August.—An article of some length giving the results of a number of experiments with liquid dielectrics.

Fundamental Ideas in Modern Physics. OSTERBERG. *Elec. Power*, June.—A brief and elementary lecture for students.

ELECTRO-CHEMISTRY AND BATTERIES.

Carbon Generator. FITZGERALD. Lond. *Elec. Rev.*, July 3.—A brief communication referring to the Jacques carbon battery and containing a letter from Mr. Crookes, written March 3, 1883, stating that he had tried an experiment with iron and carbon in fused caustic soda and obtained a good current, but he came to the conclusion that the heat required would be too high and the soda too costly to make the current an economical one. Fitzgerald thinks it a mistake to suppose that carbonic acid gas escapes in bubbles or that the composition of the sodic hydrate is not modified; his experience is that all the carbonic acid produced is absorbed by the alkali; he thinks the carbon should be protected from contact with oxygen, the stream of air being confined to the iron cathode surface; he gives the probable electrochemical equation of the arrangement "so far as it constitutes a voltaic cell."

Electrolytic Generator for Oxygen and Hydrogen. FRANKLIN. *Phys. Rev.*, July-August.—A brief description of an apparatus used in the Iowa Agricultural College; the generator consists of massive frames of an alloy of 25 parts of lead and 1 part of antimony; these constitute the walls of cells which are separated from each other by rubber joints, thus forming a series of cells of which the walls are alternately positive and negative; between the plates are a number of inclined glass strips sloping upward toward the plates, the object of which is to prevent the gases from mixing; the voltage required is 3.8 per cell; the efficiency is calculated and is found to be 38.2 per cent. at 15 cents per kw-hour; 660 litres of hydrogen and 330 of oxygen would cost about 80 cents, counting four volts per cell; this is sufficient for a strong lime light for three hours; counting oxygen only as of value, the cost would be 8 cents per cubic foot; he concludes that the electrolytic generation of these gases for laboratory purposes is not only the most convenient, but perhaps also the cheapest method of production.

Treatment of Sulphurets by the Electric Current. Eng. & Min. Jour., July 11.—A brief description of experiments made some time ago, of the Eames process for the extraction of sulphur from pyrites and sulphuret gold ores; Eames discovered some years ago that the passage of an electric current through pyrites heated to redness in aclosed vessel not only effected the separation of the sulphur, but left the resulting roast in perfect condition for pulverization and amalgamation of the gold which it contained; a large plant was erected in North Carolina, of which a brief description is given; but little has been done in the commercial application of this process.

Chemical Effects on the Electric Current. GORDON. *Elec. Power*, June.—A reprint of a short lecture before the Henry Electric Club; it is elementary in character.

UNITS, MEASUREMENTS AND INSTRUMENTS.

A One-Volt Standard Cell. HIBBERT. Lond. *Elec.*, July 3.—A brief description of a cell which he has devised, which has been in use for some years; it is in most respects like the Clark cell, except that chlorides are substituted for the sulphates, the metals, therefore, being zinc and mercury, the liquid a solution of chloride of zinc and the paste, mucurous chloride; a diaphragm is required, the details of which are of importance; Fisher found that the agreement between cells was remarkably close, their temperature coefficient negligible, and their recovery to full value after charging and discharging was much more rapid than with the Clark standard; the voltage depends chiefly on the proportion of zinc chloride in the liquid; the density required for one volt is about 1.380, and impurities are of considerable importance; the liquid is not so easy to prepare, as zinc chloride does not crystallize like the sulphate, and must therefore be purified by a more elaborate process; the density must be carefully adjusted instead of being easily defined by ration; there is an advantage in that the liquid cannot crystallize, and therefore the internal resistance, which is lower than that of the Clark cell, remains constant; it is impossible for local differences of density to arise by virtue of crystallization; the cell may therefore be claimed to be better than the Clark; the temperature coefficient is less than 0.0002 volt per 1 degree C. (that of the Clark cell is about 0.00077); a thermometer is therefore unnecessary; he has records of cells for about two years, showing a constancy as good as can be wished; a recovery curve is given after the cell was short-circuited for one minute, recovery being practically complete in four minutes.

Standard Copper. Elek. Zeit., July 2.—The standards to which the conductivity of copper is to be referred, which were adopted by the German Union of Electrical Engineers, are as follows: The specific resistance is to be given in ohms (of 1.063 mercury units) at 15 degrees C. for a length of one metre, and a cross-section of one square mm; the conductivity is to be given as the reciprocal of this value; copper whose specific resistance is greater than 0.0175 and whose conductivity is less than 57, shall not be accepted; standard copper of 100 per cent. conductivity is to be that which has a conductivity of 60; the approximate temperature coefficient is to be taken as 0.4 per cent. for 1 degree C.

Localizing Faults in Mains. RAPHAEL. Lond. *Elec.*, July 3; a continuation of his serial (see *Digest*, July 4).—He describes the Murray loop method, showing its application with the aid of several numerical examples.

The Two-Watt Meter Method Applied to Three-Phase Circuits. FRAEKENFIELD. *Wisconsin Engineer*, June.—A graphical discussion; it has the advantage that both the angle of lag and the power factor can be found without volt-ampere readings. If one has no idea of the power factor in the circuit tested, the load may be varied until one meter reads almost zero; if the readings of the other then decrease, the power factor is greater than 50 per cent. and the readings should be added; if they increase the power factor is less than 50 per cent. and the difference of the readings represents the power; this is shown by his diagram; if the instruments indicate the same amount of power, the lag is either zero or 90 degrees and the circuit is either in resonance or is entirely wattless.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Railway Telegraphs. LANGDON. *Jour. Inst. Elec. Eng.*, June.—A reprint in full of the recent Institution paper, with the discussion.

Railway Block Signaling. PIGG. Lond. *Elec. Eng.*, July 3.—The beginning of an article of a general nature including a historical sketch.

Telephone Exchanges and Their Workings. SINCLAIR. *Jour. Inst. Elec. Eng.*, June.—A reprint in full of the whole of the discussion of the recent Institution paper.

Fuses for Telegraph Circuits. STRECKER. *Elek. Zeit.*, July 2.—A reprint in full, with illustrations, of a recent paper contributed from the

German telegraph department. He gives the statistics concerning 76 cases, in which strong currents damaged telegraph apparatus; these were given in the *Digest*, July 11; he shows that the safety device should be a fuse, and of one of two kinds, the first an ordinary fuse, and the second one in which a fuse wire is surrounded by a coil of many windings, in which the heat for fusing the wire is produced; he prefers the former; numerous experiments were made to determine the fusing currents, and a table of the results is given, from which he concludes that it would not be reliable to use very fine fuse wires; a large number of resistance wires were tested and the results given in a table, which gives the diameters, which in each case were 0.07 and 0.10 mm, also the fusing current, which averaged a little above and a little below one ampere, also the spark length in millimetres which was required to destroy the wire; the latter varied from about 0.5 to 2 mm, the condenser having a capacity of 0.094 M. F. He then discusses the best mounting of this wire, and arrives at the conclusion that it is best to enclose it in a non-conducting tube which should be closed at both ends, otherwise an arc may be formed; the forms now used are illustrated in detail; in one of these the wires pass through perforations in a plate of porcelain; the fuses will stand a short circuit through 500 volts without forming an arc and will fuse with a current of about 0.8 ampere.

Telephone in Railroad Practice. Ryder. *Elec. Rev.*, July 15.—A reprint of a short paper read before the Association of Railway Telegraph Superintendents. He describes briefly the various systems which have been offered by the telephone companies and adopted for railway work; he shows the benefits derived from the operation of private exchanges in the city of Chicago; he points out the necessity of not having any connections with the public system except under certain conditions. It is thought to be a question of a short time before the telegraph will be largely superseded by the telephone; it has been shown in actual practice that messages of 30 words can be easily and intelligently transmitted in a quarter of a minute, which is about 3,900 per hour better than the average by Morse instruments and the typewriter.

Cable Laying on the Amazon River. Siemens. *West. Elec.*, July 18.—A reprint of the paper noticed in the *Digest*, June 13.

Telephone Current Measurement. Ford. *Wisconsin Engineer*, June.—A description of a new method of measuring the variation of the current in telephone transmitters; after trying a number of methods which failed, he tried an induction coil, measuring the secondary pressure to indicate the change in the primary current, and found the method entirely successful, only that a large volume of sound was required; the primary was connected in series with the transmitter to be tested and with the battery, while the secondary was connected to a quadrant electrometer, the maximum value of the current being measured with a mil-miliampere meter; by measuring the total current the percentage variation can then be found and this is the true measure of the power of any transmitter. Practically all the transmitters now in use were tested. Some tests for clearness gave the following order: Standard, National, Blake, Hunnings.

MISCELLANEOUS.

Currents for Therapeutics from Lighting Circuits. Meylan. *L'Elec.*, July 4.—An illustrated description of a small and convenient transformer for utilizing alternating currents from lighting circuits for the various therapeutical operations; it consists essentially of a transformer in which a variable number of windings can be used; it can be used simultaneously for small lights, for cauterizing and for direct application; it has been carefully calculated so that opening one of the circuits does not appreciably affect the others; for cauterizing only eight volts are used in order to prevent too great a voltage from being developed at the terminals when the cautery breaks; it has a constant potential both on open and closed circuit; the primary can be connected directly to a lamp socket; the same instrument can be used conveniently for calibrating amperemeters.

Magnetic Extraction of Iron from the Eyes. Zeit. f. Elek., June 15.—A brief extract from a recent medical paper on magnetic operations on the eye, in which it is stated that more than 1000 such operations have been performed and in each case the eye was saved; in most cases the iron splinters are removed without any trouble; in one case a splinter 16 mm in length was removed, in another case a splinter was removed after several days, suppuration having already set in, but the eye was nevertheless saved.

Cause of Milk Souring During Thunder Storms. Gerstmann. *Electrochem. Zeit.*, July.—A short note stating that lightning, being either a sudden current or an oscillating one, induces currents in all neighboring conductors and as the current strength is enormous the inductive action extends to thousands of metres, thus inducing currents that have appreciably chemical action; it is the chemical action of these currents that causes milk to become sour by the decomposition of the soluble components of the milk which produce acids and these in turn ause the milk to curdle.

Electromagnetic Plant. Zeit. f. Elek., July 1.—A note stating that in Nicaragua there is a plant called *Phytolacca Electrica* which was found to possess strong "electromagnetic" properties; when a branch is broken off with the hand a strong shock is received; the plant affects a compass needle seven to eight paces distant; in the middle of the bush the magnetic needle makes a rotary motion (!); no trace of iron was found in the earth.

Meeting of the German Union of Electrical Engineers. Lond. *Elec Eng.*, July 3.—A brief account, containing no technical information, of the recent meeting in Berlin.

Municipal Electrical Association. Lond. *Lightning*, June 18.—A large souvenir number of that journal devoted to a very full report of the entire meeting, including the papers and discussions.

Vacuum Pump. La Nature, April 25.—An illustrated description of a pump devised by Seguy, which is said to have a great capacity and to have given good results.

Biographical. Lond. *Elec.*, July 3.—An obituary notice of Prof. Alexander G. Stoletow, of Moscow; he had written a number of papers on electrical subjects, was a member of the Electrical Congress in Paris in 1881 and vice-president of the one in 1889.

Engineering Index.—The *Wisconsin Engineer*, a new quarterly publication of the University of Wisconsin, begins in its first number, June, 1896, the "Wisconsin Engineer Index," which is compiled from the technical index of the *Engineering Magazine*, the *Digest* of The Electrical World and the synopsis of current electrical literature in *Electric Power;* it is intended to cover the whole engineering field and give references to the above three sources when the summaries there given are sufficient to warrant it.

Street Lighting Convention. Prog. Age, July 1.—A full record of the proceedings held at New Haven in June, including reprints of the papers and the discussion thereof, including a few on electrical subjects, some of which have been published in The Electrical World.

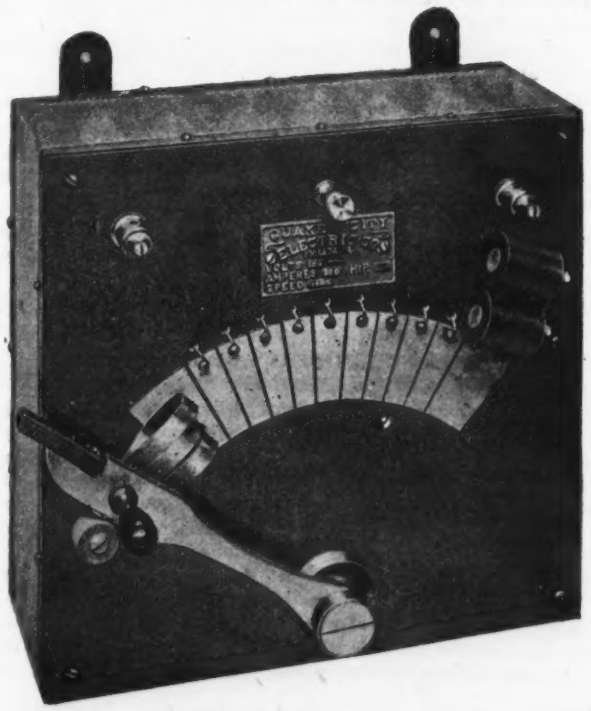
German Society of Electrical Engineers. Elec. Rev., July 15.—A brief account of the recent annual meeting.

Canadian Electrical Association. Canadian *Elec. News*, July.—A full report of the sixth annual convention, including reprints of the papers in full, with the discussion.

Features of the Recent Exposition. Elec. Power, June.—A long illustrated article devoted mainly to descriptions of exhibits, including a portion of Moore's paper before the N. E. L. A.

Automatic Motor Starter.

The automatic motor starter shown in the accompanying cut has been brought out by the Quaker City Electric Company, Philadelphia, to meet a demand among the trade for a substantial, reliable, and at the same time moderately priced automatic motor-starting rheostat. This box, while new in its entirety, combines some old as well as new principles.



Motor Starter.

The interior is made up by suspending the coiled resistance on porcelains, supported by iron cross-pieces, and the whole surrounded by a neat, open grill, permitting perfect ventilation and heat radiation. The contact plates are of cast brass, and the moving contacts of spring brass, and all of large carrying capacity. The front and back pieces are of slat,

the former being highly polished black enamel finish, making in all a fireproof, finely finished and handsome box.

Another feature worthy of note is that the operations of this box, either starting or automatically stopping the motor, are accomplished, it is said, without any sparking whatever at the contacts, thus avoiding the necessity of constantly renewing the contacts, or of having them stick and remain in any other than the full "off" position, upon failure of the current.

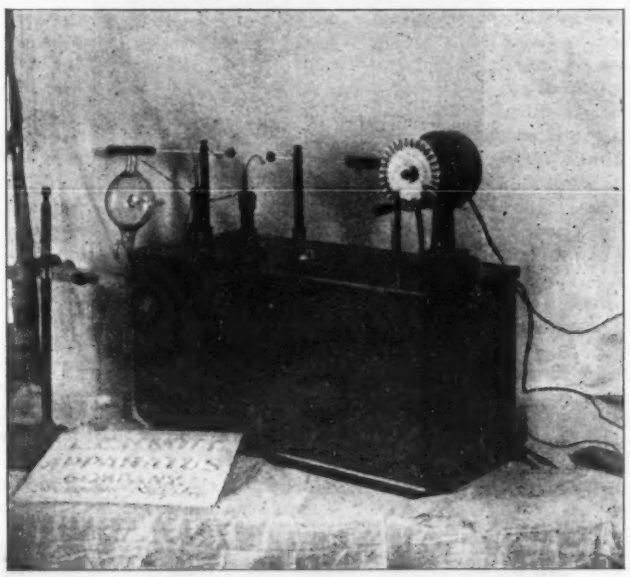
In addition to the automatic rheostat above described, this company is prepared to furnish a line of field regulators of all sizes and capacities, built in accordance with the design above referred to.

New Coil for Röntgen-Ray Work.

During the last few months the subject of exciting Crookes tubes has received much attention from electricians and scientists in general. We are not surprised, therefore, that enterprising experimenters have placed upon the market various devices which they believe to be an improvement over the old methods of exciting these tubes.

Many experiments have been performed showing the adaptability of influence machines to this work. At present, however, no satisfactory device has been hit upon by which a Holtz machine can be made to give sufficiently rapid discharges combined with durability and readiness to work under all climatic conditions. Any one of these points seem to have been attained, but to our knowledge no similar machine has yet been able to meet them all.

The induction coil seems to have been productive of better results in that it can be relied upon under all atmospheric conditions, and with proper care is not so liable to get out of order. The difficulty, however, of making complete breaks, of sufficiently high rapidity, in the primary



RÖNTGEN-RAY APPARATUS.

current has rendered this apparatus of little practical value for hospital work.

A modified form of Tesla Coil has been placed on the market by the L. E. Knott Apparatus Company, 14 Ashburton Place, Boston, Mass. The company employs a new form of transformer which transforms from 52 to about 35,000 volts. By the method employed for insulating the secondary coil each layer is surrounded by an oil of high insulating properties. A new feature has been introduced by also immersing the condenser in oil. Improvements have been made in the construction of the condenser by discarding the old method of using tin foil, and substituting a copper plate.

By an arrangement of the primary of the transformer also, either a 52 or 104-volt current can be used equally well. If the former the machine will take six amperes. If the latter, about three. When working on the number of watts here indicated a steady discharge of something over eight inches is obtained. Many of the experiments first performed by Tesla can be shown with great satisfaction with the coil here described.

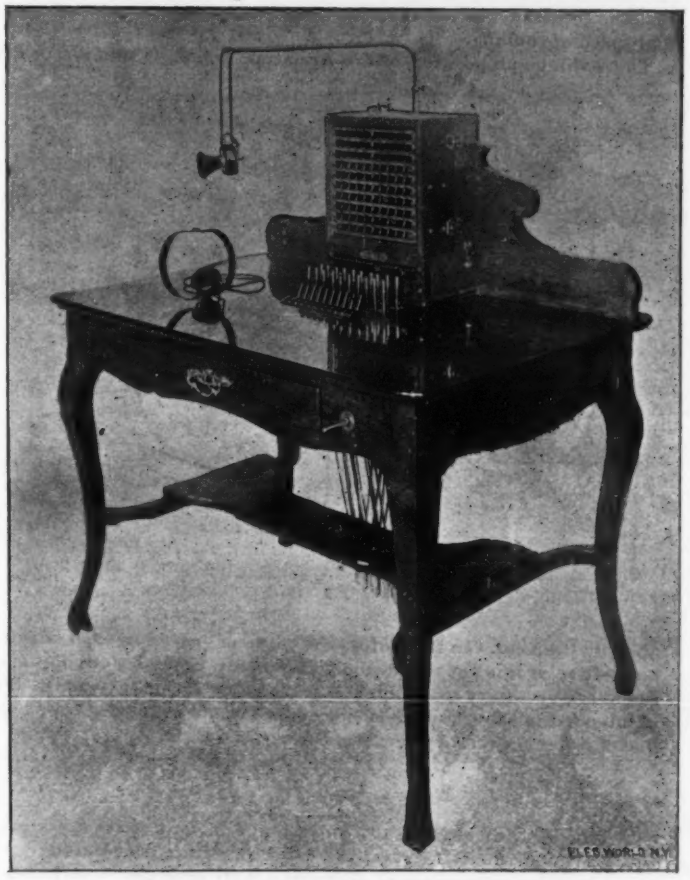
Another improvement in this coil is the mechanical spark gap, which it is claimed renders the discharge of the condenser absolutely uniform, and the rapidity of the discharge under the control of the operator. As this company also manufactures physical and chemical apparatus, it endeavors to place a coil on the market which is especially adapted for hospital work.

The company has recently issued an eight-page pamphlet on the use of Röntgen rays, and is soon to issue a new edition containing recent improvements.

Desk Switchboard.

The accompanying illustration represents the new combination desk switchboard for private telephone plants, manufactured by the Western Telephone Construction Company, Chicago. The board has a capacity of 100 wires, and has 70 drops completed. There are 30 additional drops for extension of service. The combination board includes operator's talking and signaling outfits, and is very compact.

The peculiarity of this switchboard is that the drop is directly in front of the spring jack, and when down, covers the latter completely. In



DESK SWITCHBOARD.

answering a call the operator pushes the plug against the falling drop and into the jack, thus restoring, mechanically, the drop and the connection made with the line by the one movement.

This company has an entirely new system of intercommunication between boards, several of which have been installed in large exchanges in the United States.

Street Railway Self-Starting Single-Phase Motor.

The problem of producing a successful single-phase motor which will start under load has been one full of difficulties and attended with unsatisfactory results. Commutators employed with alternating-current apparatus rapidly deteriorate and as a consequence cause continual expense to maintain them. Polyphase systems necessitate the use of more than two trolleys, introducing complications which are not received with favor by street railway people.

The Scott & Janney Electric & Manufacturing Company, Philadelphia, Pa., has recently introduced a new form of street railway self-starting single-phase motor which it is said has given very satisfactory results. It

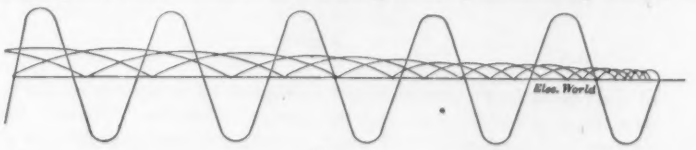


FIG. 1.

employs what is called an "induction director," shown at *B* in Fig. 2, which piece of apparatus is depended upon for the effectiveness of the system. The director takes the current from the line and supplies it to the motors connected with it. Its function is to produce a rotating field in the motor, the velocity of which being a variable, and under control, a large range of starting torque may be obtained. It has the same effect that would result if the frequency of the polyphase system were a variable and the dynamo and motor brought up to

speed at the same time. Fig. 2 shows one of the ways in which the system may be operated. *A* shows the alternating-current dynamo connected with the long-distance transmission line. *P* is a small variable-speed alternating-current motor which is employed to drive the primary circuit or the sliding contact upon either of the circuits. *B* is the induction director which is used to create a difference of potential at the circular rings, *H*, and by proper connections of the circuits with the windings upon the field produces magnetic poles which may be rotated either fast or slow and made either strong or weak, depending on the demands upon the motor. The coils upon the field and armature may be connected in series or in parallel as desired, thus obtaining a variable starting torque and speed of running.

There will be no position of the armature where it will not be acted

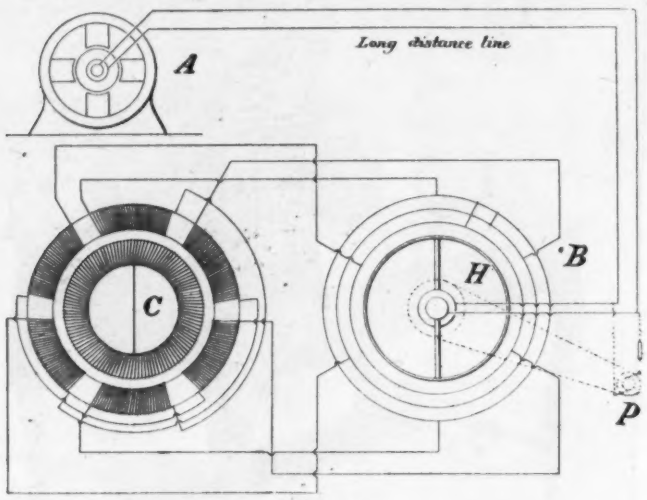


Fig 2.

upon by the field. In the motors the curve of energy in each circuit will be positive as it is not reversed, and as many different circuits may be run as are necessary to obtain the greatest mean energy curve. Fig. 1 is intended to show how the energy curve would gradually approach the line of reference for an alternating impressed E. M. F.

A New Trolley.

In The Electrical World of July 11 was given a brief description of the new Walker trolley. So radical a departure from the device that has so long been the standard warrants a more extended description than was given in the former announcement, and for the benefit of interested readers we give herewith more of the constructional details.

Instead of a wheel, this trolley has a roller 35¾ inches long, 1¾ inches in diameter. This roller is made of seamless drawn steel tubing and is case hardened. In each end is a cone made of case hardened steel, and at the end of this cone is an adjusting cone, also of case hardened steel. The bearings consist of 12 ¼-inch diameter steel balls at each end of the roller, bearing between the two cones, as shown by Fig. 1. At a speed

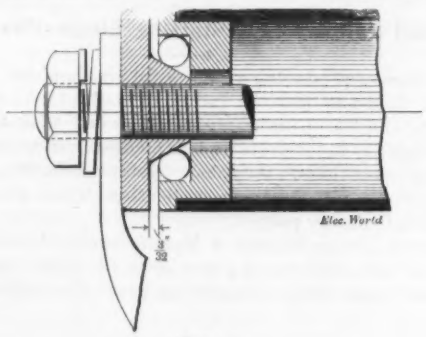
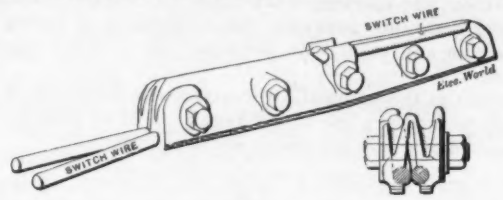


Fig. 1.

of 5000 revolutions per minute and a pressure of 30 pounds on the trolley wire, these bearings require no lubrication whatever. Through the roller passes a cold-rolled rod which retains the cone in position and supports the roller through means of the ball-bearings. The current is taken from the rod by means of small copper brushes secured to short pieces of brass tubing which revolve on the rod. This prevents the current from passing through the ball bearings, and avoids pitting of the latter due to the small contact surface.

The fork is made of malleable iron, into which is fitted two pieces of 1-inch diameter seamless steel tubing, which form the support for the rod passing through the roller. The ordinary trolley pole is used. The trolley has no lateral motion whatever, therefore it is always parallel with the track, making it impossible for the roller to leave the wire.

Fig. 2 shows a trolley line clamp which is designed to attach the switch to the main trolley line, making a very much more substantial junction of the wires. The clamp is made of one piece of cast brass, having two grooves running the full length of clamp to receive the wires, as shown in the end elevation, Fig. 3, the wire slot being wide enough to admit of placing one wire in position and leaving room enough to place the other

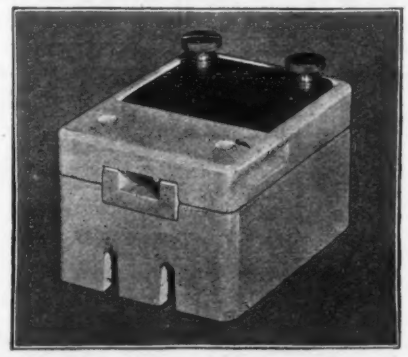


Figs. 2 and 3.

wire without disturbing the first. Then the clamp is closed up by means of four ⅝-inch bolts, as shown in Fig. 2. These bolts bring the two wires in close contact throughout the entire length. The total weight of this clamp, including bolts, is 8½ pounds.

Cut-Out Box.

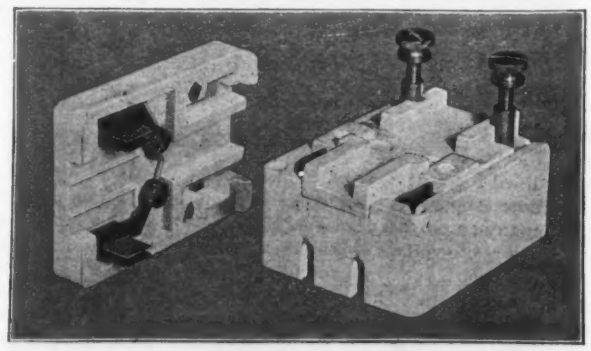
The magnetic blow-out principle with which we are familiar in the street car controllers, automatic circuit-breakers and lightning arresters, has been recently applied to the smaller currents. In the form H cut-out box the General Electric Company has provided a cheap and simple means for the protection of direct-current generators and other apparatus against the destructive effects of overloaded and short circuits, pro-



Cut-Out Box.

vided the current does not exceed 600 volts and 100 amperes. It may be fitted with fuses of any capacity from 3 amperes to 100 amperes, and any arc which may occur is instantly extinguished. Under test this cut-out box is said to have handled a short circuit of 2000 amperes at 500 volts, extinguishing the arc instantaneously.

The box is of porcelain, 5¾ inches by 4¼ inches by 4 inches thick. The fuse is secured in the cover, and when the cover is in position rests



Cut-Out Box, Cover Removed.

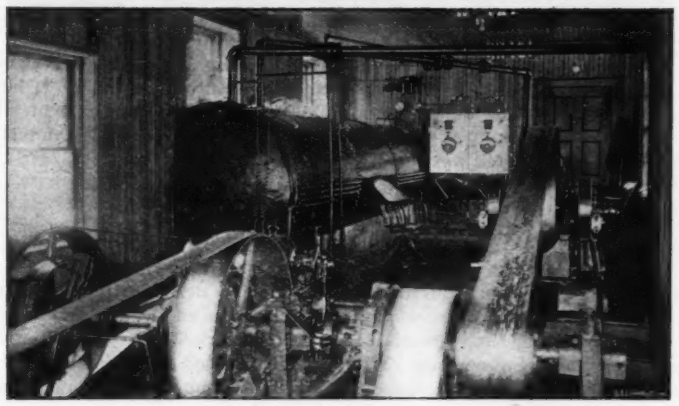
in a closed chute. The base of the box contains a small electromagnet in circuit with the fuse having its magnetic circuit continued by the iron plate on the cover and by the iron screw posts. The magnetic lines are thus compelled to pass across the space containing the fuse, maintaining a strong magnetic field in the chute when the current is flowing. At the blowing of the fuse the arc which starts finds itself in a powerful field and is immediately extinguished.

A Novel Application of Electricity.

The bridge over the Erie Canal, on Genesee Street, in Utica, N. Y., has for some time been the cause of much inconvenience to residents of that city and the canal officials, by reason of its irregularity of operation, until the method now in use was resorted to.

As originally planned the bridge had one stationary centre span and

two lifts, one on each side. Each lift was to be raised by a 15-hp electric motor, carried on the lift and operating a vertical screw, on the principle of the common screw jack, but this plan was abandoned when it was found to require about 75 horse-power on each lift to raise it. Compressed air was substituted by placing two cylinders under each lift, and attaching their pistons thereto. An air compressor was located in the old weigh-lock building, about a block distant, and was operated by a turbine wheel taking water from the canal. This plan was only a partial success, and during periods of low water in the canal the bridge had to be "hung up," as the air compressor could not run. To overcome these



ELECTRIC PLANT FOR OPERATING DRAW BRIDGE.

obstacles one of the 15-hp motors which had been on the bridge was temporarily belted to the compressor late last season. This was found to work very satisfactorily, and in the Spring an addition was made to the weigh-lock building and a permanent installation of the two motors was made by Nightingale, Johnson & Co., Utica, N. Y., under the direction of M. H. Johnson, as shown in the accompanying illustration. The installation consists of two 15-hp, 500-volt Thomson-Houston series-motors and a 20-inch turbine water-wheel belted to friction-clutch pulleys on a shaft which is also belted to a compound Norwalk air compressor. A white marble switchboard stands at one end of the room with the instruments, switches and regulating rheostats on it, and this with a small circular pump and 72 inches by 18 feet air receiver complete the equipment.

The bridge is normally operated by air at 260 pounds pressure and no difficulty has been experienced in its operation since the installation was completed.

This is quite a model plant in all details and is an instance of the great flexibility of electricity, since after being abandoned in the first instance it was again resorted to as the only means of procuring reliability and economical operation.

Electrical Specialties.

The Utica Electrical Manufacturing & Supply Company, Utica, N. Y., is placing upon the market some specialties of merit, three of which are illustrated herewith.

The arc switch, a device of new design, it is claimed will control with ease from 1 to 40 lamps. Fig. 1 shows this switch in three aspects. The switch in the first view is shown out of the box entirely, then it is shown

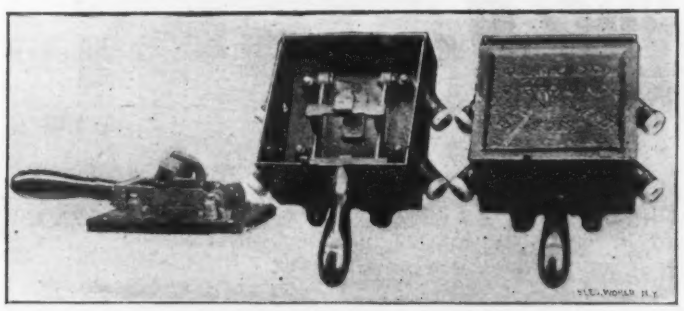


FIG. 1.—ARC SWITCH.

in the box with the cover off, and next with the cover of the box in place. This device, it will be seen, consists simply of a double-pole knife-switch with two knife-jaws that short-circuit the blades when the switch is thrown open. The action of this switch is first to short-circuit the lamp and then cut it out of the circuit, the first action being performed before the latter is begun. On throwing the lamp into circuit the reverse action takes place. The lamp is first put in the line in a short-circuited condition and then the short circuit is removed, as the switch advances in contact with the line terminals. By this method the arcing is reduced to a minimum and the reliable knife-jaw contact is utilized to good advantage.

The switch is enclosed in a neat cast-iron box with removable cover to admit of easy inspection, and the wires are let in through porcelain-bushed tubes placed at an acute angle with reference to the side of the box.

The fuse-box and lightning-arrester are illustrated in Fig. 2. The lightning-arrester is of the simple air-gap type with carbon terminals, and is provided with a fuse which blows upon receiving an excessive current caused by the arc, consequently providing an easy path to earth. While there is nothing new in the principle of construction of this arrester, the feature is its cheapness and substantiality. Like the arc

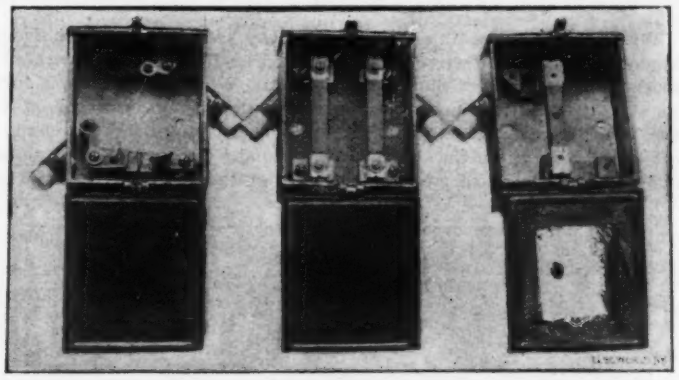


FIG. 2.—FUSE BOX AND LIGHTNING ARRESTER.

switch, it has a cast-iron cover of similar design and is provided with appropriate bushings.

The fuse-boxes have a similar appearance as regards construction. The fuse arrangement consists of a short piece of red fibre tipped with brass at the ends and adapted to fit into and bridge the gap between the knife-jaws. The fuse is secured by screws set in the brass tips. Should the fuse blow, the entire fibre with its tips can be removed and a new fuse replaced with convenience and safety.

This type of fuse can be made both single and double pole. The single-pole tip is largely used for motor fuses.

An Inexpensive Wheatstone Bridge.

The accompanying illustration represents a new and inexpensive form of Wheatstone bridge recently placed on the market by Mr. G. K. Cummings, Monadnock Building, Chicago.

The maker of these instruments has taken great pains in producing

WHEATSTONE BRIDGE.

an instrument fine in finish and accurately collaborated, and they are designed for practical use by practical men.

The detector galvanometer is very sensitive, and so constructed that it may be revolved independently of the hard-rubber engraved face-plate.

The Wheatstone bridge and rheostat, together with the galvanometer, are enclosed in a highly finished case.

The instrument complete is small and much lighter than the usual type.

One of the particular advantages is the very quick readings that can be

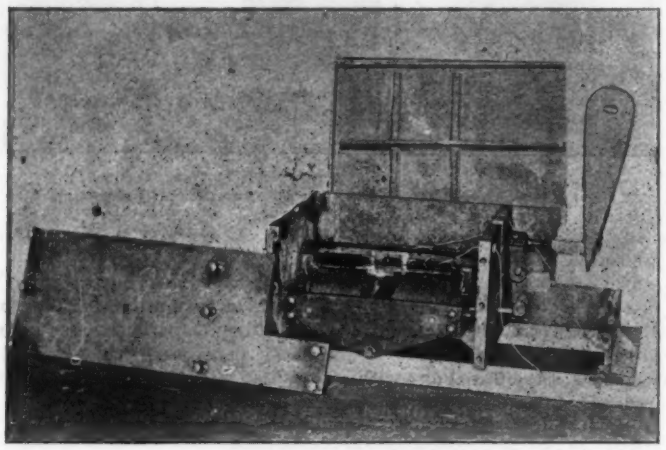
taken, it being claimed that not more than one quarter the time is required to take a reading than with the ordinary plug bridge.

The lever arms are of bronze and so fashioned that the best of contact is invariably secured. They are made in two styles ; the range of reading in No. 1 is from one one hundredth of an ohm to one million one hundred thousand. No. 2 reads from one tenth of an ohm to eleven million. Both are the same in price, the No. 1 set, however, proving the more popular, except when unusually high resistances are required.

The lock is of novel construction, positive in action, but has no key.

An Automatic Electric Railway Switch.

We illustrate herewith an electric railway switch, which is not only ingenious, but has effectively demonstrated its ability to work without a hitch for over a year without any attention. While the switch is doing its work it is securely locked, but as soon as the current is turned off it is free to be operated by hand. There is no attachment placed on either the car or trolley, but the switch is always under the control of the motorman. It is not necessary to stop the car but the switch may be turned



Automatic Switch.

while the car is approaching. A section of the track preceding the switch point is insulated, and when the car rolls upon it, if the motorman sees that the switch is not properly set, he simply turns on a little current, which passes from the wheels to the track, and must pass through the switch magnets before it can reach the main track. If, however, the switch is properly set, the car is allowed simply to coast without using current, thereby leaving the switch unchanged. A photograph of the arrangement is shown. Two powerful magnets face each other, and between them the armature is arranged so that it will

pulled from side to side, according to which magnet is energized. The motion of this armature moves the switch point and also operates the circuit charger. The contacts can only change when there is no current on the magnets ; thus there is no arcing under any circumstances. The magnets operate at a few volts only, and inasmuch as the magnets used are waterproof, the weather conductors do not affect their operation. The switch is made by the New York Switch & Crossing Company, Fifteenth and Madison Streets, Hoboken, N. J , and is certainly a practical and efficient device. It does away with the services of two men, a night man and a day man, who are frequently stationed at such places to turn the switch points as required, and even if these men were paid at the lowest rate of wages, the switch would pay for itself in less than a year.

Electric Power in a Paper Mill.

The mill of the Cliff Paper Company, Niagara Falls, N. Y., is now operated by electric power and was run for the first time in this manner on the morning of July 13. The generators are of the Card Electric Company's build. They are of the narrow multipolar type and were designed expressly for this plant. Each has a capacity of 100 kilowatts, representing 135 horse-power each. They run at a speed of 625 revolutions per minute in practice, but were built to stand 800. The most prominent features of the generators are the large armatures and the large commutators, which enable the machines to run very cool. The generators are self-regulating and self-oiling, and are fitted with self-aligning bearings. They were installed by S. E. Huenerfauth, of the Card Company, and this gentleman will remain in charge of the plant for a short time, or until it is delivered to the Cliff Company. In connection with the water-wheel plant is a Lombard recording speed indicator made by the Lombard Water Wheel Governor Company, Boston, and a Replogle governor, made by the Replogle Governor Company, Akron, O. With these devices there is every certainty that regularity of speed will be obtained.

In the mill itself, which is situated at the top of the cliff, are the motors which drive the shafting of the paper machines. The motors were manufactured by the American Engine Company, Bound Brook, N. J. Each motor is wound for 500 volts, and is of the four-pole type, of 100 horse-power. It was found that it required more than 100 horse-power to move the shafting and get the paper machines under way, so a smaller motor was installed, and the two supply the necessary power and drive the machines at sufficient speed. Although the 100-hp motor alone was overloaded it carried the load easily through a continuous run of 24 hours. The company is now engaged in building two 150-hp motors, which it is expected will handle both machines in the mill with ease. The tests of the plant it is stated were most satisfactory.

Boiler Attachment.

The accompanying illustration is of a device designed for application to return tubular boilers, which is being introduced by the C. B. Attachment Company, No. 10 Warren Street, New York City.

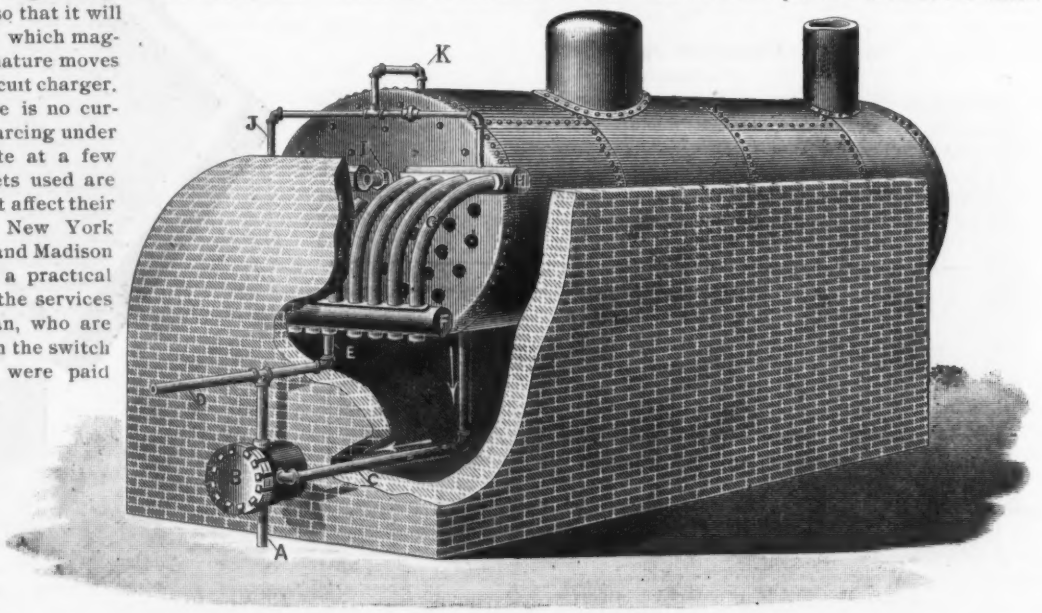
The attachment consists of an arch composed of tubes and headers, which forms the support of the arch over the combustion chamber, a mud trap and the pipes connecting them to the boiler.

The tubes in the "arch" are expanded into the headers, and the headers are supported by the rear and side walls of the furnace. The upper header is connected to the boiler by a pipe, *I*, which passes through the head of the boiler above the flues, which pipe is extended forward into the boiler past the centre, and this "discharge pipe" is perforated, and also left open at its end.

The pipe *L* is connected with the lower header, *F*, and the mud trap *B* at its top, and another pipe, *C*, called the "bottom circulating pipe," connects the side of the mud trap with the bottom of the boiler. *A* is the blow-off pipe ; *J* is a small pipe connecting with the top of upper header near each end, and with the steam space in boiler at *K*. This is the "equalizing pipe." *D* is the feed water connection.

The object of this appliance is to make a permanent support for the arch over the combustion chamber ; utilize the heat which burns out the brick arch and cracks open rear walls, taking up the heat thus absorbed and radiated, making the brick work sound and lasting ; to produce a circulation through the arch and boiler, which by this circulation removes all sediment from the boiler, depositing it in the mud trap, from which point it is blown out.

Steam is rapidly generated in the tubes, and by their form and arrangement the circulation through them is very rapid. Having a supply of water at the lower end of each tube it is not possible to force the water



Boiler Attachment.

of any tube by the steam, and the rapidity of circulation prevents any formation in any part of the attachment.

A novel feature of this attachment is that it fulfills the functions of a feed-water heater or of a circulator. When not acting as a feed-water heater it generates steam and acts as a circulator.

It is claimed that this device will save at least 10 per cent. of fuel; prevent scale from forming; keep the boiler free from a deposit of dirt, and preserve the furnace walls and arch as sound as when first built.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, July 18, 1896.

THE ELECTRICAL STOCK MARKET in general shows marked declines in prices on the week's business. Trading seemed to be extremely dull, the most prominent stocks in the different classes suffering the greatest decline.

WESTERN UNION sold at much lower figures than those obtained the previous week, the net result being a loss of 5¼.

GENERAL ELECTRIC, with the rest of the list, suffered a marked decline, the result of the week's transactions showing a loss of four points as compared with the previous week. There were 25,321 shares traded in.

EDISON ELECTRIC ILLUMINATING COMPANY, NEW YORK.—The June report of the Edison Electric Illuminating Company, New York, and that for six months ending June 30, show the following results as compared with the same periods last year:

	1896.	1895.	Increase.
Gross	$159,068.02	$147,637.40	$11,430 62
Net	67,412.30	72,273 72	5,861.33 Decrease.
Gross, six months	$1,105,904.64	$1,015,948.19	$89,956.45
Net six months	544,532.99	491,002.32	53,530.67

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Brooklyn, reports gross earnings for June of $57,725, an increase of $24,702 as compared with the same month of last year, and net $22,059, an increase of $14,070. For the six months ending June 30 the gross earnings were $403,412, an increase of $154,369 as compared with the corresponding period of last year, and net $181,136, an increase of $76,966.

SPENCER, TRASK & CO., bankers, this city, have issued a neat little pamphlet concerning the Edison Electric Illuminating Companies of New York and Brooklyn, and giving valuable statistical information about these concerns, for the information of investors.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	118¼	..
Edison Electric Ill., New York	100	*95	96
" " " Brooklyn	100	99	102
" " " Boston	100	135	140
" " " Philadelphia	100	140	..
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	22	23
Electric Storage, pref	100	24½	26
General Electric	100	22⅜	22¾
General Electric, pref	100	71	73
Westinghouse Consolidated, com	50	26¾	27½
" " pref	50	49½	51

BONDS.

Edison Electric Ill., New York	105	109	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	85	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	200	201
American District Telegraph	100	29	39
American Telegraph & Cable	100	..	91
Central & South American Telegraph	100	124	127
Commercial Cables	100	130	..
Erie Telephone	100	58	59
New England Telephone	100	94	95
Postal Telegraph-Cable	100	72½	75½
Western Union Telegraph	100	78	78¼

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	16⅛	16¼
Brooklyn Rapid Transit		20	20½
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	..	66
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	40	42
Hestonville	100	49	50
" pref		..	62½
New Orleans Traction	100	10	13
" " pref	100	..	60
North Shore Traction	100	20	23
" " pref	100	70	72
Rochester St. Ry	..	..	20
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	14½	14¾
West End, Boston	100	68	69
" " pref	100	87	88
Worcester Traction	100	14	16
" " pref	100	90	93

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	78½	80
Buffalo St. Ry. 1st con. 5s	100	104	*107
Cleveland Elec. Ry. 1st mtge 5s	100	100	*103
*Columbus St. Ry. 1st 5s	100	93	*97
Rochester St. Ry. 1st 5s	100	99½	*102
Union Railway (Huckleberry) 1st mtge 5s		102½	105
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

FINANCIAL REPORTS.—The Scranton Traction Company reports gross earnings for June of $23,274, an increase of $2407 as compared with the same month of last year, and net $15,112, an increase of $590. For the year ending June 30 the gross earnings were $330,307, an increase of $59,68c as compared with the corresponding period of last year, and net $166,279, an increase of $52,834.

TRACTIONS.—Offerings were very small and what little business was transacted had a tendency to force down prices. The market was featureless, Worcester traction preferred being the only exception to the general sacrifice of values. The weakest stock in the traction list was Columbus Street Railway, which dropped from 48 a few days ago to 41 on liberal offerings.

THE PATERSON RAILWAY COMPANY reports gross earnings for June of $27,050, a decrease of $3113, as compared with the same month last year, and net earnings of $12,004, a decrease of $1350. For the six months ending June 30, the gross and net earnings compared with the corresponding period of last year showed an increase respectively of $22,147 and $14,157.

THE NEW ORLEANS TRACTION COMPANY reports gross earnings for May of $125,698, an increase of $2262 as compared with the same month of last year, and net $55,258, a decrease of $2880. For the five months ending May 31 the gross earnings were $568,163, an increase of $48,740 as compared with the corresponding period of last year, and net $256,655, an increase of $30,738.

DIVIDENDS.—The Columbus Street Railway Company has declared a quarterly dividend of 1 per cent., payable Aug. 1.

BONDS LISTED.—Among the bonds listed on the New York Stock Exchange during the last week were $53,000 additional Terre Haute Electric Railway 6's.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, July 20, 1896.

FRANKLIN S. TERRY, vice-president of the Sunbeam Incandescent Lamp Company, Chicago, is on an Eastern trip and called at the office of THE ELECTRICAL WORLD last Wednesday.

DEATH OF MR. GAMEWELL.—Mr. John N. Gamewell, inventor of the fire-alarm telegraph system bearing his name, died in Hackensack, N. J., on July 19, of heart disease. Mr. Gamewell was born in Marlborough, N C, and was 74 years of age.

MANHOLE EXPLOSION.—The cover of a manhole of the Edison Electric Illuminating Company's subway at the corner of Bleecker Street and Broadway, blew off on the morning of July 13, with considerable noise. Pieces of the manhole were thrown 100 feet in the air. Fortunately, no one was hurt. The explosion was caused by the accumulation of gas.

THE ELECTRICAL EXPOSITION.—The management of the recent Electrical Exposition has returned thanks to E. S. Greeley & Co. for the use of the golden key employed in transmitting the message of Dr. Chauncey Depew around the world to Edward D. Adams, on the evening of May 16 last. The same key was used by President Cleveland in opening the World's Fair at Chicago in 1893.

RESIGNED.—Mr. Frank A. Thayer, who was for some years general manager of the Goubert Manufacturing Company, New York, has severed his connection with that concern and accepted a position with the Aultman & Taylor Machinery Company, Mansfield, O. Mr. Thayer's new duties will be in connection with the selling department of the Aultman-Taylor Company's Cahall vertical and Babcock & Wilcox horizontal water tube boilers.

THE ELECTRICAL ENGINEERING & SUPPLY COMPANY, of Syracuse, N. Y., is constructing a switchboard for the Y. M. C. A. Building, New York City. The board is of Italian marble, 9 feet by 8 feet, upon which is mounted 19 switches, of different sizes; three Weston ammeters, round pattern; two Weston voltmeters, round pattern, and three Carpenter enamel rheostats, The dynamos in this plant have capacities of 25, 50 and 75 kilowatts. Mr. C. H. Warner, New York, is the consulting engineer of the plant.

DEATH OF W. O. LEWIS.—Mr. W. O. Lewis, who built the first telegraph line from New York to Sandy Hook, and who was intimately connected with the ship news service of the press associations, died in Germantown, Pa., on July 15. He was one of the early advocates of the feasibility of the Atlantic cable and was a warm friend of Cyrus W. Field. When the Boston & New York Telegraph Company was organized he became one of the managers. It was largely owing to his industry and intelligence that the line was put upon a paying basis. He was widely known among the telegraphic fraternity.

A CHANGE OF BASE.—Mr. Rodney Thayer, late manager of the Atlantic district of the Babcock & Wilcox Company, New York, has severed his connection with that company and become associated with the Aultman & Taylor Machinery Company, Mansfield, O., in its sales department of water-tube boilers. Mr. William Thayer, who was for 14 years connected with the sales department of the Babcock & Wilcox Company, New York, and for the past

eight years manager of the New England district, has also resigned and is now associated with the Aultman & Taylor Machinery Company, of Mansfield, O.

New England Notes.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., July 17, 1896.

MR. C. R. REMINGTON, JR., of the American Electrical Works, Providence, R. I., favored this office with a call this week. He was looking well and happy.

MOTOR-CARRIAGE EXHIBITION.—Among the features of the Rhode Island State Fair Association, which will be held in Providence on Sept. 7–11 next, will be an exhibition and races of motor-carriages. The points forming the basis of awards will be speed, control, simplicity, cost, maintenance and appearance.

MARRIED.—Mr. Frederick A. Swan and Miss Emma Ida McDaniels were united in marriage June 29 at Keene, N. H. Mr. Swan, from his long and prominent connection with the electrical business in Boston, enjoys a large circle of friends, who will wish for him and his bride the fullness of happiness and prosperity.

THE AMERICAN ELECTRICAL WORKS, Providence, R. I., as is well known, is fortunate in the young men connected with it. All of them have made creditable records for themselves. One of them, Mr. F. B. Baker, who has been with the company for the past six years, has been chosen to "circulate" among its friends and patrons in New England.

THE BEACON LAMP COMPANY, Boston, will, on or about Sept. 1, locate at New Brunswick, N. J., in a new brick lamp factory now being constructed, 200 x 100 feet and 2½ stories high. The principal reasons for removing to New Brunswick are the excellent shipping facilities afforded, and the increased export trade of the company generally, shipped from New York.

MR. J. M. ATKINSON, of J. M. Atkinson & Co., Chicago, Ill., sole owners of the Horseshoe Rail Bond, has been in Boston recently in conference with L. A. Chase & Co., his New England agents. Mr. Atkinson is a wide-awake, go-aheadative business man, and there are not many points missed by the indefatigable Sears B. Condit or his associate, Mr. Chas. E. Sprague.

THE BOSTON GEAR WORKS, 31 Hartford Street, Frank Burgess, proprietor, has just issued its new catalogue for 1896. The Boston Gear Works claims to have the largest list of gears printed, either brass or iron, containing in all 3230 sizes. The catalogue will be mailed to any one sending in his address. By strict attention to business and almost ceaseless energy, Mr. Burgess has built up a successful business of which he should be proud.

THE GENERAL ELECTRIC COMPANY has recently installed four G. E. 800 motors on the new highway bridge across the Connecticut River connecting Middletown with Portland, Conn. Two of these are connected with the swinging mechanism, one working and the other being held in reserve. Of the other two, one is located under each end of the turning span, to raise it from the fixed piers before the third motor begins to swing it. The bridge span is 450 feet long—the longest single-span highway bridge in the world. Previous to the installation of this electrical equipment 15 men were required to start the bridge and eight men to swing it.

THE MANUFACTURERS' STREET RAILWAY COMPANY, New Haven, Conn., has purchased the first electric locomotive of any considerable size built in this country, exhibited by the General Electric Company, at the Chicago Exposition, 1893, and having a rated drawbar-pull of 7000 pounds. It is equipped with air brakes and is being prepared for shipment from the Schenectady works within a very few weeks. Its total weight is 30 tons, and it will be utilized to haul freight cars from the junction of the New York & New Haven Railway at Cedar Hill, which is about one mile from the New Haven passenger depot to the works of the Bigelow Company, manufacturers of boilers; the National Pipe Bending Company, the Quinnipiac Brewing Company, the New Haven Rolling Mills and other manufacturing establishments located along the water-front at some distance from the freight yards of the Consolidated Road. The freight cars will be hauled directly into the yards of the manufacturers, and the loads will be collected by the electric locomotive and hauled to the main line of the New York, New Haven & Hartford Railway, where they will be taken up by the steam locomotive for transportation to their destination. The length of the line along which this locomotive will run is nearly two miles, the maximum grade against the load being about 2½ per cent. The guaranteed speed of this locomotive on this grade will be seven miles an hour with a heavy load behind it.

Western Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., July 17, 1896.

UNDERGROUND CABLE CONTRACT.—It is reported that the Standard Underground Cable Company, Pittsburg, has been awarded the contract for underground cables for the police and fire alarm service in Pittsburg.

ELECTRA CARBONS.—The reputation of the Electra carbon for brilliancy, length of life and freedom from dust is well known wherever the carbon has been used. The Electric Appliance Company, Chicago, is general Western agent.

DECISION.—We are informed that the United States Court of Appeals in Cincinnati has affirmed the decision of the United States Circuit Court, recently given in favor of the Pierpoint Boiler Company, in the litigation on the Fowler patent for water tube boilers.

CAHALL BOILERS.—Mr. W. C. Turner has accepted a position with the Aultman & Taylor Machinery Company, Mansfield, O., in its sales department of Cahall boilers. Mr. Turner was for several years connected with the sales department of the Babcock & Wilcox Company, New York.

DENVER, COL.—The two-story brick building of the Denver Consolidated Electric Light Company was destroyed by fire on the evening of July 13. The building contained 16 Westinghouse dynamos valued at $5000 each, and the total loss is said to be $130,000. It is said that the fire was caused by the crossing of wires at the switchboard.

Notes of the Marinette Convention.

H. ANDRAE, of Milwaukee, represented J. Andrae & Sons' Company.

THE BADGER ELECTRIC COMPANY, Racine, Wis., was well represented by Mr. P. H. Korst.

THE GENERAL ELECTRIC COMPANY, Chicago, was represented by Messrs. Bunce & Boyer.

ANCHOR ELECTRIC COMPANY, of Boston, was well represented by its popular Western representative, Mr. C. O. Baker.

THE BANQUET AND BALL will never be forgotten. For full information our readers had better ask those who were in attendance.

THE SUNBEAM INCANDESCENT LAMP COMPANY, Chicago, was well advertised throughout the convention hall and hotel.

THERE were a great many inquiries for Mr. T. S. Gordon, that well known and popular representative of the J. A. Roebling's Son's Company.

THE PEOPLE'S ELECTRIC COMPANY, Madison, was most ably represented by its well-known Western business hustler, Mr. L. W. Burch.

MR. W. W. LOWE, president of the Electric Appliance Company, Chicago, as usual made himself a leading spirit of the convention in his old peculiar style.

THE CENTRAL ELECTRIC COMPANY, Chicago, was represented by Mr. H. D. Latimer, who is one of the best known gentlemen in the electrical business.

MR. T. R. MERCIEN, of Milwaukee was one of the leading representatives of the convention, and very ably looked after the interests of the Milwaukee Fire Alarm Company.

MR. JOSEPH M. HILL kept reminding his friends that the Wagner transformers are strictly "In It." This gentleman is quite a convention favorite, and has hosts of admirers and friends.

MR. A. C. BUNCE, of Milwaukee, was, as usual, one of the leading spirits of the association, and never lost an opportunity in making his weak but melodious voice heard from one end of Marinette to the other.

MR. GEORGE CUTTER was to be seen fluttering in and out of the Marinette Hotel in bicycle costume, in which he looked remarkably well, and seemed to be thoroughly contented with himself and everybody else.

THE WESTINGHOUSE GLASS COMPANY'S interests were looked after by its newly-appointed western representative, Mr. W. E. Donley, who worked hard all the time maintaining the position of his celebrated house and thoroughly succeeded.

MR. C. H. McGILL, the well-known and popular hustler, never lost sight of the fact that he was representing the Ohio Brass Company and the Akron Insulator & Marble Company. This gentleman was very popular and in demand on all occasions.

LESCHEN-MACOMBER-WHYTE COMPANY was well represented by its secretary, Mr. George S. Whyte. This gentleman was a particular request on all occasions, and it was whispered round that he had made quite a reputation for himself among the "Feathered Tribe" of the woods.

MR. JAMES WOLFF did the honors for the New York Insulated Wire Company, of New York, and was eminently successful in keeping the Grimshaw wire before his numerous friends. He is one of the most popular attendants at all Western conventions, and never seems to lose sight of the fact that G-r-i-m-s-h-a-w spells Grimshaw.

THE FORT WAYNE ELECTRIC CORPORATION'S interests were well and ably taken care of, and could not have been placed in better hands than those of its well known representative, Mr. C. E. Wilson. This company's exhibit was a special feature and can be credited with saving the life of many a weary traveler on his arrival at headquarters at small hours in the morning. This company, fortunately for the boys, never lost sight of the fact that "Man cannot live on bread alone."

Canadian Notes.

MONTREAL, CAN., July 18, 1896.

MONTREAL, QUE.—The Montreal Park & Island Railway have recently let the contract for the construction of the St. Vincent de Paul Branch to be completed this Fall

AN ENGLISH SYNDICATE is considering the question of leasing the Metropolitan Street Railway. The matter of the extension of the line to Richmond Hill is understood to be a part of the deal.

THE CANADIAN ELECTRIC RAILWAY & POWER COMPANY is seeking incorporation, with power to build an electric railway from Coburg to Niagara Falls, *via* Port Hope, Bowanville, Oshana, Whitby, Toronto, Oakville, and Hamilton.

HULL, QUE.—At the first annual meeting of the Hull Electric Railway Company, held recently, arrangements were made for building loop lines and erecting a large Summer hotel at Hull. Mr. Alexander Fraser was elected president and Mr. H. D. Spencer managing director.

TORONTO, ONT.—Messrs. Dewart & Renev, solicitors, have given notice that application will be made to the Dominion Parliament for an act to incorporate the Toronto Radial Railway Company with power to take over the franchise of the Toronto Belt Line Railway Company, and to convert the present belt line railway into an electric road.

ST JOHNS, N. F.—An electric railway is being arranged for St. Johns, to be operated between the city and the suburban villages, within 20 miles, the plant to be driven by water, of which there is any quantity in the different rivers near the city. The promoters are hopeful of its prospects, despite the snows of Winter, which are likely to interfere with its working.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, July 8, 1896.

MUNICIPAL PURCHASE.—On Wednesday, July 1, the Liverpool Corporation took over the business of the Liverpool Electric Supply Company, paying £400,000 for the privilege.

INSTITUTION OF CIVIL ENGINEERS.—Mr. James Forrest, who has for so many years been secretary to the Institution of Civil Engineers, and to whom its present paramount position in the engineering world is mainly due, has, after long absence due to continued ill-health, been obliged to resign his position. His successor is his late assistant, Dr. J. H. Tudsbery.

ELECTRIC LIGHTING FRANCHISES.—In a report issued by the Board of Trade respecting the number of applications for electric lighting franchises during the past year, it is stated that 39 franchises were asked for, 31 being granted; 24 were to local authorities and seven to companies. At the present moment there are no less than 240 franchises in force in the United Kingdom, 167 belonging to local authorities and 73 to companies.

ELECTRIC TRACTION FOR BIRMINGHAM.—The Public Works Committee of the Birmingham Corporation has just issued a lengthy report with regard to an application made on behalf of Mr. W. McKenzie, of Toronto, and Mr. J. Ross, of Montreal, asking for the consent of the corporation to an assignment to them of the lease now held by the Birmingham Central Tramways Co., the lease to be subsequently extended for a period of 21 years. After prolonged negotiations the basis of an agreement was formed, and the Public Works Committee have warmly recommended the acceptance of the scheme.

THE ELECTRIC LIGHTING OF THE THAMES EMBANKMENT.—Our great London municipal body, the London County Council, has for some years past been dallying with the by no means tremendously big job of lighting the Thames Embankment, and the scheme is still in such a state that the following motion, which is down for discussion at the next meeting, remains necessary: "That in the opinion of the Council it is desirable that the Victoria Embankment and Westminster and Waterloo bridges, should, without further delay, be lighted by electricity as authorized by Act of Parliament, with a view to further relieving the congested state of the traffic in the Strand and Fleet Street."

General News.

NEW INCORPORATIONS.

THE MUTUAL TELEPHONE COMPANY was organized at Erie, Pa., by members of the Board of Trade, with a capital stock of $60,000.

THE EGYPT ELECTRIC COMPANY, Cairo, Ill, capital stock, $40,000, has been formed by William Kluge, Henry Hasenjaeger, Albert Lewis and C. V. Neff.

THE SNOW SIGNAL COMPANY, Brunswick, Me., has been organized by Gilbert Maxwell, president, and Eugene Thomas, treasurer, and others. Capital stock, $50,000.

THE FARADIZER COMPANY, Indianapolis, Ind., capital stock, $100,000, has been formed by Turner D. Bottom, Carl C. Hartman, James C. Hamilton, Indianapolis, Ind.

THE AUGUSTA STREET RAILWAY & ELECTRIC COMPANY has been incorporated at Augusta, Ga. The capital stock is $50,000, with the privilege of increasing it to $2,000,000.

THE ZANESVILLE RAILWAY & ELECTRIC COMPANY, Zanesville, O., has been incorporated with a capital stock of $500,000, by Frank A. Durban, Kenyon B. Conger, Thomas J. McDermott, Henry R. Newkirk and A. H. Johnson.

THE ATLANTIC COAST ELECTRIC LIGHT COMPANY, Asbury Park, N. J., has been incorporated with a capital stock of $500,000. The incorporators are, John E. Comins, of Arlington; Arthur D. Chandler, of Orange, and John B. Summerfield, of Brooklyn.

THE PHILLIPSBURG ELECTRIC LIGHTING, HEATING & POWER COMPANY, Phillipsburg, N. J., has been incorporated with a capital stock of $25,000. The incorporators are Jacob B. Smith, John H. Haggerty, E. D. Pursel, William H. Reaser, George Hubschmitt, John Eilerberg.

THE ELIZABETHTOWN ELECTRIC HEAT & POWER COMPANY has been granted a charter by the State Department at Harrisburg, Pa. The directors are Isaac W. Hoffman, E. E. Coble, B. G. Groff, A. B. Denny, Elizabethtown, Pa., and N. Welchans, Lancaster, Pa. Capital stock, $9000.

THAYER & CO., Boston, Mass., have been incorporated by Winthrop Thayer, Rodney Thayer, Frank A. Thayer and W. C. Turner, to act as general Eastern agents for the Cahall vertical and Babcock & Wilcox horizontal water tube boilers, manufactured by the Aultman & Taylor Machinery Company, Mansfield, O.

THE NORTHERN TELEGRAPH & TELEPHONE COMPANY has been incorporated in New York State with a capital stock of $30,000. The directors are M. B. Sloat, of Mount Vernon; M. G. Brownell, Alfred Rindskopf and William I. Miller, of New York City; S. J. McCrimlisk and Joseph H. McCormick, of Brooklyn, and Daniel F. Wing, of Hackensack, N. J.

THE UNITED STATES & HAYTI TELEGRAPH & CABLE COMPANY, Albany, N. Y., has been incorporated with a capital stock of $1,800,000, the route and points to be connected to be as follows: From New York City to Coney Island, thence by submarine cable to the Island of Hayti in the West Indies, and from New York City through the States of Connecticut, Rhode Island and Massachusetts to Boston. The directors are John W. Mackay, George Clapperton, Albert Beck, John Beattie and Charles E. Merritt, of New York, and Albert B. Chandler and Edward C. Platt, of Brooklyn.

TELEGRAPH AND TELEPHONE.

MACOMB, ILL.—The Mercer County telephone line is to be extended to this place.

BOSCOBEL, WIS.—A branch telephone line has been extended to this place and an exchange is being installed.

DUNKIRK, N. Y.—The Automatic Telephone Company has been granted a franchise to do business in this city.

MT. VERNON, O.—The telephone line has been extended from this city to Johnsville *via* Darlington and Woodbury.

HOLLAND, MICH.—The Citizens' Telephone Company's line between this city and Grand Rapids has just been successfully opened.

TELEPHONE COW-CALL.—It is stated that the farmers in the West are trying to adapt the long-distance telephones to call the cows home at night.

SYRACUSE, N. Y.—The Western Telephone Construction Company, it is reported, will open a branch office in this city for the purpose of a headquarters for New York State business.

BOSTON, MASS.—The 4255 shares of Bell Telephone stock, which were sold at auction on July 11, were purchased by a syndicate represented mainly by Messrs. Blake Bros. & Co., and J. P. Morgan & Co.

BALTIMORE, MD.—The Henry McShane Manufacturing Company has applied to the County Commissioners for permission to place telegraph poles on Willow Spring Avenue, from Dundalk to Fifth Avenue.

TORONTO, ONT.—The chairman of the Board of Control is receiving tenders for the privilege of constructing and maintaining a telephone service for the citizens of Toronto for a term of five years or longer.

TROY, N. Y.—The North Argyle Union Telephone Company is extending its lines from Argyle to Cossayuna Lake. This will give a direct connection between Fort Edward and Salem. The new line will be completed about Aug. 15.

JEFFERSON, O.—The City Council of this place has granted a combination franchise to the Madison, Jefferson & Warren Telephone Companies to be operated jointly. The charge for instruments will be $15 for residences and $21 for business houses.

ELECTRIC LIGHT AND POWER.

NIAGARA FALLS, ONT.—The Niagara Falls Metal Works Company will install an electric light plant.

LISTOWELL, ONT.—The Council have passed a by-law to raise $15,000 for the purpose of putting in electric light.

KALSO, B. C.—Mr. Bostock has arranged for the floating of $30,000 of debentures, and arrangements will be made to secure electric light.

WAYLAND, N. Y.—Fifty incandescent lights of 32 candle-power each are to be installed in the streets of this place at a yearly cost of $700.

BEMENT, ILL.—The Bement Electric Light & Power Company will erect a new power-house and install new engines and boilers at once.

PROVIDENCE, R. I.—The Board of Aldermen, by a vote of six to three, defeated the measure looking to the construction of a municipal electric light plant.

OTSEGO, MICH.—The Village Board has granted a franchise to Messrs. Buckhout & Arnold to furnish this city with 20 arc lights to be ready for use by Oct. 1.

MINNEAPOLIS, MINN.—A municipal conduit system is quite certain to be built this year, and it will be large enough to accommodate all the electric companies. Such a system will cost $50,000, and will necessitate a bond issue if the work is to be done this year.

BROOKLYN, N. Y.—The Edison Electric Illuminating Company has filed a protest with the Board of Assessors against the assessment of $627,000 on the company's personal property. Secretary Peabody declares that no assessment whatever should have been levied.

BROOKLYN, N. Y.—The Citizens' Electric Light Company has put in a protest against the assessment on its personalty of $627,000. It claims that it should pay on nothing, because of capital invested in patents and in stock of other corporations. Last year it paid on $375,000.

WORCESTER, MASS.—It has been decided to recommend to the City Council that a three years' contract for arc lights of 2000 candle-power be made on the basis of 33 cents a light per night. The present contract price is 35 cents. This decision was reached at a conference of the street lighting committee of the City Council, with representatives of the Worcester Electric Light Company.

THE ELECTRIC RAILWAY.

FREDERICK, MD.—There is a project on foot to build an electric railway between this city and Thurmont.

CHATHAM, ONT.—The City & Suburban Electric Railway Company also desire a contract for street lighting.

HADDONFIELD, N. J.—The Borough Commissioners contemplate the construction of a trolley road in Haddonfield.

YOAKUM, TEX.—There is talk of organizing a company in Yoakum, with the view of establishing a street car system.

ATLANTA, GA.—It is reported that the Consolidated Electric Railway Company has bought the Atlanta Electric Railway.

MADISON, WIS.—The Madison Street Railway is to be extended from its present Western terminus on University Avenue to the cemetery.

HACKENSACK, N. J.—There is to be a new road constructed in Hackensack. It is to be called the Hackensack & Lodi Railway and will be about one and a half miles long.

HARTFORD, CONN.—Philadelphia capitalists are interested in a scheme to build an electric road between Hartford and Springfield. The route proposed is by way of Agawan and Suffield.

BUFFALO, N. Y.—The traffic on the Buffalo & Niagara Falls Electric Railroad is very heavy. On Monday, July 13, there were 33 cars in service, running every six minutes, and these were taxed severely.

WASHINGTON, D. C.—The F Street line has been transformed into the trolley system and electric cars are now running along that road. The horse cars are being gradually displaced by the electric.

DETROIT, MICH.—The Detroit Railway has been sold to R. T. Wilson, of New York. Mr. Wilson has bought four fifths of the stock, the recent owners of the Detroit Railway system retaining the bonds.

BATAVIA, N. Y.—It looks now as if the Batavia Street Railway Company would be an accomplished fact before very long. The company has leased offices in this city and commenced preliminary work.

BROCKTON, MASS.—At the meeting of the Board of Alderman the Brockton Street Railway Company filed a bond of $20,000 to build, equip and operate a street railway line to North Easton within six months.

FALL RIVER, MASS.—A special meeting of the Board of Aldermen will be held to give a hearing on the petition of the Fall River Street Railway Company for a location in the Durfee and Bank Streets extensions.

WHITE PLAINS, N. Y.—The New York, Elmsford & White Plains Railway Company filed its acceptance of the franchise granted to it by the Board of Trustees of Tarrytown, and deposited the $10,000 bond required.

LOWELL, MICH.—Municipal electric lights were turned on in this place a few nights ago, and the citizens made the occasion one of great festivity. Their joy manifested itself in the form of band-music, fire-crackers and the firing of cannon.

WORCESTER, MASS.—There is a scheme on foot for an electric railway from Worcester to Mount Wachusett. Among the principal promoters of the enterprise are Col. Asa L. Kneeland, of Worcester; Daniel C. Miles, of Westminster, and others.

WORCESTER, MASS.—It is reported that the Board of Railroad Commissioners has refused to approve the lease of the Worcester & Shrewsbury Railroad and the Worcester & Shrewsbury Street Railway by the Worcester Consolidated Street Railway Company.

BROOKLYN, N. Y.—The Nassau Electric Company has petitioned to be relieved from payment of any taxes on its personal assessment of $2,000,000. The company contends that it should pay nothing whatever inasmuch as its indebtedness exceeds the value of its assets.

READING, PA.—The Metropolitan Electric Company has just placed an order for four Brush dynamos, each of 125 lights capacity, which will be operated by water-power at Big Dam. The current thus generated will be utilized in incandescent lighting and for the Union Traction Company's service.

JAMAICA, L. I., N. Y.—The Village Trustees of Jamaica held a special meeting at which a franchise was granted to the Long Island Electric Railway to lay tracks over that section of the Jamaica and Hempstead turnpike, extending from Grand Street to the Eastern boundary of the village corporation.

AUGUSTA, GA.— A communication from Col. D. D. Dyer, president of the Augusta Railway & Electric Company, stated that it was the company's desire to move its tracks, if possible, from Twelfth Street, to Eleventh Street. The question was referred to the Railway and the Streets and Drains Committee.

HAGERSTOWN, MD.—The Hagerstown Railway Company has at last determined to extend its line to Fair Ground Avenue, instead of crossing Broadway, and ordinances have been passed by the City Council, which were approved and accepted, providing for an additional line on South Jonathan Street.

BROOKLYN, N. Y.—The Brooklyn City Railroad Company has applied to the Board of Assessors for a reduction of the personal assessment on that corporation from $2,250,000 to nothing. President Rossiter gave much testimony as to the affairs of the company in his examination on the application.

OVERCROWDING CARS.—The South Brooklyn Board of Trade has adopted a resolution denouncing the overcrowding of the Nassau trolley cars as both dangerous and immoral. It also calls on the Aldermen to pass an ordinance compelling the railway companies to provide a seat for each passenger from whom a fare is collected.

CHICAGO.—The foreclosure sale of the South Side Elevated Railroad, otherwise known as the Alley "L," will take place on Wednesday, Sept. 15. It is ordered under a decree of Judge Hanecy, and will place the owners of the road in a position for immediate action as to a change of motive power and consideration of plans for extension and terminals.

BALTIMORE, MD.—The Edmondson Avenue, Catonsville & Ellicott City Railway Company, which is the local end of the Columbia & Maryland Boulevard Railway between Baltimore and Washington, has applied for permission to make a branch line to connect with the Baltimore & Catonsville Short Line Railway which recently passed under its control.

DAYTON, O.—The Wayne Avenue and the White Line Street Railway Company has been consolidated with the following officers: Dr. J. E. Lowes, the Hon. John A. McMahan. The new company will be known as the Peoples' Street Railway Company, and will be capitalized at $1,100,000. The new company will begin at once equipping the Wayne Avenue division with electricity.

SPRINGFIELD, O.—Col. S. L. Nelson, of this city, head of the local street railway line, has returned from Joliet, Ill., where he closed a deal for the purchase by the syndicate of the Joliet street railway system. Steps will be taken at once to secure the right of way for a road to Chicago. The projectors intend to build at once, and expect to have the line in operation in a short time.

BEATRICE, NEB.—The Beatrice Electric Company has announced some important changes to be made soon. The machinery in the two plants is to be consolidated at once, after which the tracks west and south of the Blue River will be taken up and a new line run out to the State Institute for Feeble Minded Youth. The tracks to the Chautauqua grounds will be rebuilt and straightened up; the work to be completed before the opening of the Gage County Fair.

PITTSBURG, PA.—The directors of the Pleasant Valley Traction Company on July 6 received the formal proposition of the owners of the Second Avenue line for the sale of the same. It is likely that the deal will be carried through. It is stated that the purchase of the Pleasant Valley line is the beginning of a movement for consolidation which will form a powerful rival to the Consolidated Company. The new company will probably be called the North Side Traction Company.

LEASE RATIFIED.—At a special meeting of the stockholders of the New York & Harlem Railroad Company, held on July 15, the lease of the Fourth Avenue horse car line to the Metropolitan Street Railway Company was unanmously ratified, and like action was taken by the stockholders of the Metropolitan Street Railway Company. The latter company assumed possession of the property at once. The Fourth Avenue line will now be known as the Fourth Avenue Division of the Metropolitan Street Railway system.

BROOKLYN, N. Y.—On Sunday last the Brooklyn Heights Railroad Company, without any previous notice, laid and completed a single track line down Rockwell Place from Fulton Street to Willoughby Street. This sudden action and the fact that the work was done on Sunday caused considerable comment, and it has been charged that there was no legal authority for laying the line. The authority, however, is said to have been granted by the Corporation Counsel and that the action of the railway company was proper. The object of building this line is to relieve the congested traffic on Fulton Street by diverting a portion of it over another branch.

Trade and Industrial Notes.

THE TECHNIC ELECTRICAL WORKS, Philadelphia, Pa., has issued an artistic catalogue of their switches and switchboards. The catalogue is well illustrated with examples of the work turned out by this concern.

THE NEW YORK FILTER COMPANY, 145 Broadway, New York, has issued a pamphlet describing its filter system which is adaptable to boilers. It removes all grease from condensed steam water. A large number of these devices are in constant use.

THE WATERTOWN STEAM ENGINE COMPANY, Watertown, N. Y., in a neat pamphlet just issued, describes its well-known direct-connected, high-speed engines. The illustrations are exceptionally fine, and show various styles of engines direct-connected to electric generators.

THE CAHALL WATER-TUBE BOILER.—The Aultman & Taylor Machinery Company, Mansfield, O., has just issued a pamphlet giving the reports of various tests made upon Cahall vertical water-tube boilers in different plants. These reports are very favorable to this make of boiler.

THE KESTER ELECTRIC MANUFACTURING COMPANY, Buffalo, N. Y., reports that it is doing a very large business in its dynamo brushes for this season of the year, and is receiving a large number of orders for the same. Mr. Atherton of the company, who is now in England, has secured some large orders both in London and Liverpool for the Kester Company's Niagara battery and dynamo brushes.

THE MOORE-HOLDEN MACHINE FOUNDRY COMPANY, of Fort Worth, Tex., is a new company, consisting of J. F. Moore and W. Holden, who were for the past few years associated with the Texas Iron & Brass Works of that city. They will do a general repair and machine business, and are opening up on quite an extensive scale. They have purchased their entire outfit of tools of the Davis & Egan Machine Tool Company, Cincinnati, O., and expect to be ready for operation in the course of about 30 days.

THE J. H. McEWEN MANUFACTURING COMPANY, New York, reports the following sales for the month of June Dynamos: 60-kw belted and 100-kw direct-connected to McEwen engines, to Jeffrey Manufacturing Company, Columbus, O.; 50-kw and 100-kw direct-connected to McEwen engines to Bissell, Dodge & Erner Company, Toledo, O.; 100-kw and 150-kw belted machines to Link Belt Machinery Company, Chicago; 30-kw belted to Jeffrey Manufacturing Company, Columbus, O.; 20-kw belted to New York Safety Insulated Wire Company, New York; one 400-kw and one 200-kw direct-current machines to McEwen tandem compound engines, to Tacony & Frankford Electric Railway Company, Tacony, Pa. This is the second order by this company, the first having been for two 200-kw direct-connected generators to McEwen tandem compound engines.

THE HAZELTON BOILER COMPANY, New York City, reports recent sales of boilers aggregating 2450 horse-power, among which are the following: The Rochester Gas & Electric Company, Rochester, N. Y., 500 horse-power; the Bristol Electric Light & Railway Company, Bristol, Conn., 200 horse-power: the Canandaigua Electric Light & Railway Company, Canandaigua, N. Y., 250 horse-power. Many of the recent sales have been made to old customers, who are now enlarging their plants. The original boilers sold to these customers have been in constant operation for from eight to ten years, without repairs. This, together with the fact that the Hazelton Company has made various improvements in the construction and setting of its boilers, increasing their efficiency and economy and improving their appearance, makes it much easier for it to make sakes now than formerly.

Business Notices.

The illustrations in this issue were made by the Photo-Engraving Company, 67–71 Park Place, New York.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 7, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building. New York.]

563,250. MULTIPLE SWITCHBOARD SYSTEM FOR TELEPHONE EXCHANGES; O. A. Bell, of Brooklyn, N. Y. App. filed May 19, 1892. The combination in a spring jack of two line-springs, a test-ring in front of the presenting ends of said line-springs and insulated from them, and an extra contact piece insulated from both the said line-springs and the test-ring, but adapted to be crossed with said test-ring by the insertion of the plug into the jack.

563,254. ELECTRIC RAILWAY; H. Brandenburg, Chicago, Ill. App. filed April 16, 1895. The combination with the conduit formed with the integral upwardly-extending webs, of a slot rail rigidly secured to one of said webs, and a co-operating slot rail hinged to the other web, and having a recessed seat for the edge of the web whereby the conduit may be readily opened.

563,257. LIGHTNING-ARRESTER AND AUTOMATIC FUSE BLOCK; T. L. Carleton, New Orleans, La. App. filed Feb. 28, 1894. In an automatic fuse-box and lightning-arrester, the combination of a conducting-bar, a non-conducting bar, fuse-wires extended across from one bar to the other, a contact-arm mounted to successively engage the fuse-wires, a motor connected to move the arm, and mechanism capable of regulating the operation of said motor, and making the movement of the arm regular and uniform.

563,262. APPARATUS FOR HEATING THERMOPILES; E. N. Dickerson, New York, N. Y. App. filed March 8, 1892. The combination of a casing through which the thermopile elements project, the said casing containing in itself, or a continuation thereof, apparatus for heating the gas burned beneath the thermopile and a suitable burner for burning the heated gas.

563,263. CABLE HANGER; A. S. Diehl, Chicago, Ill. App. filed Jan. 21, 1896. In a cable-hanger, the combination with a supporting hook, of a flexible strap adapted to encircle the cable, one end of which is bent back to form a pivotal connection for said supporting-hook and means for securing the other end of the said strap to the pivotal connection.

563,269. COMBINED ANNUNCIATOR AND FIRE ALARM; M. Garl, Akron, O. App. filed Sept. 27, 1894. In an electric annunciator, the combination with a battery and a main conductor leading therefrom, of a series of magnets, each connected with the terminal of said main conductor, a series of visual signals actuated by said magnets, return circuits connected to each of said magnets and leading to the battery, a push-button, electric bells and thermostats arranged in groups throughout the building, the push buttons being arranged in the return-circuits and the bells and thermostats in shunt-circuits, a magnet arranged in the thermostat-circuit, a sliding bar carrying an armature controlled by the magnet, a series of contacts, one for each bell carried by said bar and adapted to engage corresponding contacts to simultaneously close all the bell circuits, push-buttons adapted to close each of the bell-circuits separately, an auxiliary battery, and a circuit-closer operated by the sliding bar for throwing said battery into circuit with the main battery when all the bell circuits are closed.

563,273. MEANS FOR INSULATING ELECTRIC CONDUCTORS; T. Guilleaume, Mulhein-on-the-Rhine, Germany. App. filed March 19, 1895. The combination with a naked electric conductor, of a tubular envelope of non-conducting material angular in cross-section, and twisted so as to present in its internal surface spiral prominences with which the conductor is alone in contact.

563,274. ELECTRIC CABLE; T. Guilleaume, Mulhein-on-the-Rhine, Germany. App. filed Nov. 2, 1895. An electric cable in which grated or ground vegetable fibre or bark (such as cellulose, cork, tan and the like), either in a natural state or saturated with an insulating substance is employed as an insulating medium, the latter being retained in position about the conductor by means of a braiding or tubular covering.

563,282. ELECTRIC RAILWAY; E. Lachmann, Hamburg, Germany. App. filed June 30, 1894. In an underground electric railway, the combination with the underground conduit, a drainage channel above the same, and a surface slot leading to said channel, of a lateral passage opening into the drain above its bottom and into the conduit at the bottom thereof.

563,290. METHOD OF AUTOMATIC CURRENT REGULATION OF DYNAMO-ELECTRIC MACHINES; F. H. Loveridge, Coldwater, Mich. App. filed Aug. 6, 1894. The method of varying the E. M. F. developed by a dynamo-machine to maintain the volume of the current at a practically uniform value under the changes of circuit resistance which consists in maintaining two portions of the field at a uniform magnetic moment, said portions being those intersected by the line of commutation, varying the resistance of that portion of the circuit comprising the coils of the portions of the field intermediate of the said uniform portions and reversing the polarity of the current traversing said coils, the variations in resistance and the direction of the current through said coils being effected automatically and in response to changes in the current traversing the external circuit.

563,294. APPARATUS FOR SELECTIVE SIGNAL SYSTEMS; F. R. McBerty, Downer's Grove, Ill. App. filed Aug. 23, 1895. The combination with a signaling circuit having several selective signaling instruments connected with the same conductor thereof, of a separate spring jack or connection-socket for each signaling instrument connected with the circuit, a generator of signaling current and means for applying it to any spring jack, and a device in connection with each spring jack adapted to determine the operation of the corresponding signal.

563,304. ELECTRICALLY CONTROLLED BOAT STEERING APPARATUS; C. E. Ongley, New York, N. Y. App. filed Dec. 20, 1892. The combination of a rudder, cable and means for moving it, means for connecting the cable and rudder, and a magnet in a suitable circuit normally holding said means out of engagement with the rudder.

563,315. ELECTRIC ARC LAMP; C. E. Scribner, Chicago, Ill. App. filed Jan. 2, 1893. The combination in an electric arc lamp with a pivoted switch lever adapted to make and break contact, of a carbon rod and a friction-spring mounted upon the lamp frame and adapted to hold said switch lever in either of two positions, to which it may be moved by the upward and downward movement of the rod.

563,318. BRIDGING BELLS; C. E. Scribner, Chicago, Ill. App. filed March 6, 1891. In a sub-station calling apparatus, the combination with a source of electricity, and an electromagnetic ringer located at a sub-station, said ringer being provided with an electromagnet wound with two coils, of a pair of normally closed contact-points located at said sub-station, and adapted when closed to complete a short circuit around the source of electricity and when open to place said source of electricity in series with the bell, and a pair of normally open contact points located at said sub-station and adapted when closed to complete a short circuit about one of the coils.

563,319. INCANDESCENT LAMP; C. E. Scribner, Chicago, Ill. App. filed July 20, 1891. The combination with an exhausted bulb of glass, of a film of carbon or other refractory conducting material deposited upon the inner surface of the bulb, and leading in wires sealed into the bulb making electrical connection with the film. (See Illustration.)

563,320. MULTIPLE SWITCHBOARD SYSTEM FOR TELEPHONE EXCHANGES; C. E. Scribner, Chicago, Ill. App. filed March 5, 1892. The combination with the core of an electromagnet, of a magnetizing helix thereof, an additional normally open-circuited coil encircling the same core, and means for closing the circuit of said additional coil in short circuit.

563,321. INCANDESCENT LAMP; C. E. Scribner, Chicago, Ill. App. filed May 9, 1893. The combination with a bulb provided with a neck having a slot therein, of a filament and its stem, means for supporting the stem within the neck of the bulb, and a plate separate from the said stem removably sealed over the opening in the neck.

563,322. TELEPHONE CIRCUIT; C. E. Scribner, Chicago, Ill. App. filed June 16, 1893. The combination with a line circuit, of a receiving instrument and a source of current connected with the line at one station, and at another station a receiving instrument, and a source of current in different parallel branches of the circuit, and a source of E. M. F. in the branch with the receiving instrument adapted to oppose the passage through the receiving instrument of current.

563,323. TESTING APPARATUS FOR MULTIPLE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed Nov. 13, 1893. The combination with a balanced telephone-line circuit, of a test-plug connected with one side of the line, a ground branch including resistance from the same side of the line, and a telephone grounded at its centre bridged between the sides of the circuit from a point between the ground branch and the telephone, whereby a test of a grounded contact piece may be made without disturbing the balance of the line.

563,324. ELECTRIC POLICE SIGNAL SYSTEM; C. E. Scribner, Chicago, Ill. App. filed May 14, 1894. In combination, a signaling-circuit, signal-transmitters in the signaling-circuit adapted to interrupt or vary the current therein, a telephone return-circuit, telephones in parallel bridges between the signaling-circuit and the return-circuit, a signal-receiving instrument in the signaling-circuit, and means for interrupting the return-circuit at any station upon the signaling-circuit.

563,325. SYSTEM OF CURRENT DISTRIBUTION FOR SUB-STATION TELEPHONES; C. E. Scribner, Chicago, Ill. App. filed Jan. 28, 1895. The combination with an electric circuit, including serially a telephone transmitter and a telephone receiver at different stations, of a condenser in the circuit intermediate of the two stations, a source of electric current and an impedance-coil in a parallel or shunt circuit with the condenser, whereby current is supplied in the telephone-circuit for operating the telephone-transmitter.

563,326. CONTACT POINT FOR ELECTRICAL INSTRUMENTS; C. E. Scribner, Chicago, Ill. App. filed Aug. 17, 1895. The combination with a pair of switch-springs, of contact-wires of platinum or other non-corrosive metal on the adjacent surfaces of the switch-springs in planes substantially at right angles to each other, the ends of each wire being passed through perforations in the spring and bent back upon the spring to secure the wire thereto.

563,327. TELEPHONE-EXCHANGE SWITCHBOARD; C E. Scribner and E. P. Warner, Chicago, Ill. App. filed Feb. 7, 1890. A switchboard-table provided with separately-removable plug-sockets arranged along the longitudinal centre of the board and the spring-jack switches placed on opposite sides of said sockets.

563,329. PROCESS OF BUILDING UP CARBON FILAMENTS; F. S. Smith, Pittsburg, Pa. App. filed Aug. 20, 1892. The process of increasing the conductibility of an incandescent electric-lamp filament, which consists in heating the filament in a rare medium, together with anthraquinone.

563,333. SPRING JACK FOR TELEPHONE SWITCHBOARDS; H. B. Thayer, New York, N. Y. App. filed July 5, 1895. In a spring jack switch, the combination with a pair of terminals or contacts connected with the opposite sides of a telephone line, of a connecting plug adapted to be inserted into said switch, and carrying contacts adapted to engage said terminals, a thimble forming one terminal of an electric circuit and mounted in front of said pair of terminals, a flexible tongue forming the other terminal of said electric circuit and resting opposite said thimble, said plug being provided with a sleeve adapted to be inserted between said thimble and said tongue to electrically unite the same, the flexible tongue serving to press the sleeve firmly against the thimble and thus ensure a good electrical contact between the sleeve, the thimble and the contact spring.

563,335. CIRCUIT RE-ESTABLISHING CUT-OUT; A. L. Tucker and F. H. Loveridge, Chicago, Ill. App. filed Aug. 8, 1895. In a cut-out the combination with a pair of contacts normally in engagement to complete the electric circuit, of means for separating said contacts when the circuit is interrupted at any point, means for effecting a single return of said contacts to their position of engagement to momentarily complete the circuit therethrough, and means for maintaining said contacts in engagement when the continuity of said circuit has been restored, whereby the cut-out acts to re-establish the circuit, if the circuit external to the cut-out be re-established, while it the external circuit remain open, the contacts are permanently separated.

563,336. ELECTRIC SIGNALING APPARATUS; F. W. Turner, Newton, and W. M. Chapman, Needham, Mass. App. filed April 18, 1891. In an electric signaling apparatus, the combination of an electric circuit, a signal-box containing a signal-transmitter and an answer-back bell, the former operating and the latter operated by said circuit, a signal-receiving instrument operated by the circuit, and a non-interference, answer-back signal-transmitter, comprising a motor-driven circuit-changing device, and an electromagnet included in or controlled by said circuit, which releases said circuit-changing device and thereafter controls its action.

563,337; BRUSH FOR ARC DYNAMOS; H. H. Wait, Chicago, Ill. App. filed Aug. 20, 1895. The combination with a main brush of an independently fed auxiliary brush situated at the tip or leading edge of the main brush.

563,342. CABLE TERMINAL ATTACHMENT; A. T. Welles, Chicago, Ill. App. filed March 3, 1896. An electric cable terminal attachment or strip consisting essentially in the combination with connecting-blocks of a casing of insulating material having plates above and below said blocks, an insulating compound filling the space remaining within said case, and means for connecting the safety-fuses and the distributing wires respectively with said blocks.

563,352. INDIVIDUAL CALLING APPARATUS; W. W. Alexander, Kansas City, Mo. App. filed April 8, 1893. The combination of a carriage having ratchet-teeth, a propelling lever and a retarding device having its shaft resting upon a yielding support, and so constructed and arranged that the combination-carriage will be propelled by a short impulse a distance not an equal multiple of the distance propelled by a long impulse.

563,360. APPARATUS FOR THREADING CONDUITS OR PIPES; T. J. Cope, Philadelphia, Pa. App. filed March 4, 1895. In an apparatus for threading conduits or pipes, a head, a tailpiece, a carrier, rods common to said head and tailpiece, a forked wedge having reactive means supported between its prongs, and slotted lugs attached to its sides, said lugs serving as guides, and stops serving to limit the extent of movement of said carrier.

563,374. AUTOMATIC BLOCK SIGNAL AND ANTI-COLLISION APPLIANCE FOR RAILWAYS; H. W. Harris, Raleigh, N. C. App. filed May 14, 1895. The combination with T-spikes having their horizontal arms bent downwardly, and provided with insulators which carry the conductors of a forked trolley, the arms of which are adapted to contact with the said conductors, and whose end portions are bent upwardly behind and above the said conductors to form positive hooks, adapted to forcibly engage the said conductors upon lateral movement of the trolley.

563,379. FLEXIBLE MICA INSULATING SHEET; C. W. Jefferson, Schenectady, N. Y App. filed March 16, 1895. An electric insulator in sheet form, consisting of layers of fibrous and mica sheets and gutta-percha tissue between any and every two of said layers.

563,387. COMBINED PESSARY AND WOMB BATTERY; M. E. Keller, Port Worth, Tex. App. filed July 31, 1895. A pessary comprising a cup of aluminum lined with silver, a silver stem, and a zinc plate arranged at the base of the stem and in the bottom of the cup.

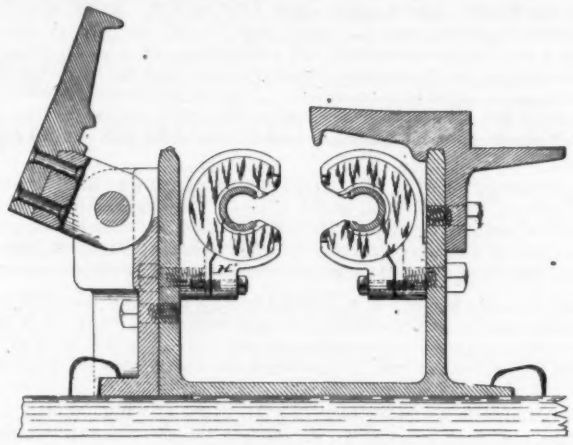
563,395. TELEPHONE TRANSMITTER; W. A. Moore, Brooklyn, N. Y. App. filed March 25, 1896. In a telephone transmitter the combination of a diaphragm, a recessed block set opposite said diaphragm, a ring of soft non-conducting material intermediate the diaphragm and the block and surrounding the recess therein, a solid carbon placed in the recess, a quantity of finely-divided conducting material placed intermediate the diaphragm and the carbon and means for independently adjusting the position of the block and the position of the carbon with relation to the diaphragm.

563,407. ELECTRIC SWITCH; C. G. Perkins, Hartford, Conn. App. filed April 1, 1896. In an electric switch in combination, a base of insulating material supporting stationary-conducting contacts and spring-brushes, a cap with a central perforation and a single segmental perforation, and a rotary spindle that extends through the cap from the inside to the outside, said spindle outside of the cap bearing a handle by means of which it can be rotated and within the cap supporting a threaded nut, a block of insulating material loosely connected with the nut and rotating therewith, said block bearing conducting-pieces that are adapted to connect and disconnect the contacts and brushes as the block rotates, a spring with one end connected with the spindle and the other end with the nut, and a lettered disc secured to the upper end of the nut adjacent to the inside of the cap so that the lettering will rotate directly with the block bearing the connecting and disconnecting pieces and indicate absolutely through the perforation in the cap after each movement of the nut and block the position of the connecting and disconnecting pieces.

563,424. MECHANICAL MOVEMENT; E. A. Sperry, Cleveland, O. App. filed Nov. 11, 1893. A pivoted shifter, notches thereon located on each side of its pivot, a finger-like actuator for said shifter, co-operating with said notches, the actuator having a forward and backward movement, in combination with means whereby the insufficient movement of said shifter by the actuator in its said forward movement is corrected upon its backward movement.

563,426. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed Jan. 30, 1895. The method of transfering an electric translating device, or circuit containing such devices, from a circuit of given frequency to a second circuit of different frequency, which consists in first changing the frequency in the device or circuit to be transferred so as to correspond with the desired frequency after the transfer is made, and then making such transfer.

563,427. COMPOUND-WOUND MULTIPHASE GENERATOR; C. P. Steinmetz, Schenectady, N. Y. App. filed March 19, 1896. In combination, two separate armatures connected in quadrature and energized by different fields, independent circuits extending from each armature, and independent compounding and regulating means in each of the circuits.



No. 563,254.—ELECTRIC RAILWAY.

563,428. STORAGE BATTERY; W. J. Still, Toronto, Can. App. filed Sept. 18, 1894. In a storage battery, a series of conducting-plates all of the same polarity, interposed active material, elastic means for binding the plates together at right angles to their adjacent faces, all the plates having an unbroken surface extending from end to end, flexible bowed extensions from said plates of different length forming a wedge-shaped end and a correspondingly shaped saddle.

563,440. ELECTRIC MOTOR; E. J. Berg, Schenectady, N. Y. App. filed Oct. 8, 1895. As a means of indicating synchronism of an alternating-current motor, one or more incandescent lamps connected across the field terminals.

563,442. ELECTRICAL SIGNALING APPARATUS; S. S. Bogart, Schraalensburg, N. J. App. filed Oct. 16, 1894. In an electrical apparatus, an answer-back provided with a winding and checking mechanism, in combination with circuit-closing devices connected therewith and actuated thereby when released, means actuated by the movement of the answer-back mechanism when released to first close a circuit, and thereby actuate a signal or other device, and then send a return message to line.

563,443. ELECTRICAL SELECTOR; S. S. Bogart, Schraalensburg, N. J. App. filed Jan. 5, 1895. In an electric selecting instrument, a movable device actuated by the armature of an electromagnet to the end of its phase, in response to impulses from a transmitter, means for retarding the backward throw of the armature between the impulses, thereby preventing it from completing its backward throw and means for returning the selector to zero, actuated by the same armature in completing its backward throw when the actuating impulses cease.

563,453. MAGNETO-ELECTRIC MACHINE; P. J. Crouse and E. W. Milgate, Utica, N. Y. App. filed Sept. 7, 1895. The combination in a magneto-electric machine, with the magnets and rotary armature, of the armature shaft mounted in fixed bearings, a gear pinion on the armature shaft, a main driving shaft having a driving gear-wheel meshing with the pinion and mounted in a fixed bearing at one end of the machine, and in an adjustable bearing-piece at the end on which the driving-gear is mounted, the adjustable bearing-piece having a guide or slide directly between the shafts and slotted openings and the set screws.

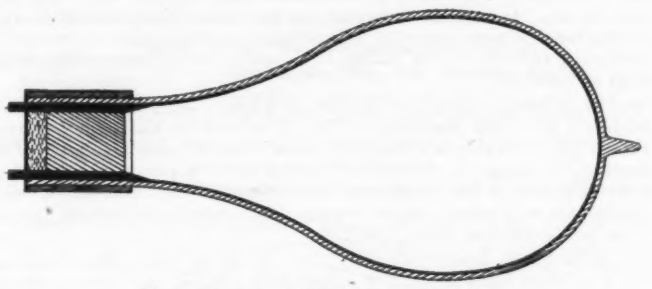
563,474. AUTOMATIC FIRE ALARM; J. W. Frost, New York, N. Y. App. filed Feb. 18, 1888. In an electric alarm system, a signaling mechanism provided with distinct signaling devices, an electromagnetic controlling device therefor, circuit controllers governing the said electromagnetic controlling device, the said circuit controllers being each provided with three or more contact parts in groups of two, all in combination with circuits and connections whereby on the operation of either or both groups of contact parts definite signals will be transmitted (See Illustration.)

563,475. THERMOSTAT AND CIRCUIT THEREFOR; J. W. Frost, New York, N. Y. App. filed March 28, 1890. In an alarm system, one or more expansible elements and two points of contact co-operating therewith, and arranged at different distances from the said expansible element or elements, in combination with a subordinate alarm-circuit connecting the nearer co-operating parts, a subordinate alarm-circuit connecting the more

distant co-operating parts, and a main alarm-circuit connecting all the co-operating parts, whereby distinctive signals will be sent on the closing of either contact and of all the contacts.

563,482. INSULATING SUPPORT FOR RAILS OF ELECTRIC RAILWAYS; P. Haley, Chicago, Ill. App. filed March 9, 1896. The combination with a rail and an insulating block secured thereto, of a base having a hollow standard adapted to support said insulating block, and a hollow bifurcated spindle adapted to enter said block.

563,501. IN-AND-OUT INDICATOR; J. P. Milbourne, Monton, England. App. filed Dec. 26, 1895. In combination in an "in" and "out" indicator for office use, a switch lever in the office projecting from the wall to serve as a pivoted hat-peg, an "in" and "out" contact for the lever, "in" and "out" circuits leading from the switch-lever and contacts to the outside of the office, an indicator for said circuits including the electromagnets and the push-buttons for closing either circuit when the switch-lever is in connection with the contact thereof.



No. 563,319.—INCANDESCENT LAMP.

563,531. TROLLEY CATCHER; C. F. Wilson, Brooklyn, N. Y. App. filed March 6, 1896. A tender comprising a winding mechanism for receiving the trolley-operating rope, a support, swinging dogs pivoted to the winding mechanism, a link connecting the dogs for causing them to mutually operate, and means for holding the dogs out of engagement with the support under an ordinary movement of the winding mechanism and for permitting them to engage the support under an extraordinary movement of the winding mechanism.

563,544. SPEED INDICATOR; T. O. Bateman, Fort Worth, Tex. App. filed July 20, 1895. A speed indicator for vehicles, comprising a casing, a governor mounted therein, gearing connecting the governor with a moving part of the vehicle and lever mounted in the casing and connected to the governor, an insulated plate sustained in the casing, two contact points on the plate, a contact plate moving past the contact-points and actuated by the lever, signals and electric connections.

563,546. TROLLEY-WIRE FROG; M. F. Bean; Springfield, Mass. App. filed Jan. 29, 1896. A trolley frog for trolley-wire lines, consisting of a body, a main-line track and one or more branch-line tracks, in which the adjoining points of said tracks on the surface of said body approach each other with such degree of proximity that they are mutually engaged within the circumferential groove of the trolley, at the instant of the passage of the latter from one of said points onto the other, combined with suitable trolley guards on said body for engagement with a side of said trolley during its said movement from and onto a point of said tracks.

563,575. REVERSING CONTROLLER FOR ELECTRIC MOTORS; A. C. Dinkey, Munhall, Pa. App. filed Sept. 3, 1895. A rheostat having arc-shaped main contact-plates through which the current always passes in the same direction, separated series of resistances having two sets of contact blocks, and an arm arranged to move over said arc-shaped plates and said contact blocks in opposite directions and thereby reverse the current.

563,586. AUTOMATIC REPEATER; J. W. Frost, New York, N. Y. App. filed Aug. 16, 1892. In an automatic repeater, a circuit-breaking device mounted upon the armature of an electromagnet, the said circuit-packing device consisting of a disc having an insulating portion and a contact spring bearing upon the disc, a clock-work adapted to engage with the said circuit-breaking device, and a spring for restoring the disc.

563,599. MAGNETO-ELECTRIC GENERATOR; A. G. Leonard, New York, N. Y. App. filed Aug. 10, 1894. The combination with a rotary armature of a magneto or dynamo-electric generator, and a driving pinion fixed to rotate with the shaft or spindle of the generator, of a drive wheel provided with a circular yielding corrugated or roughened surface in position to engage the periphery of the driving pinion, the engagement of the yielding surface with the pinion being such as to permit a slipping under a sudden impulse imparted to the drive-wheel.

563,600. RHEOSTAT FOR ELECTRIC MOTORS; H. W. Leonard, New York, N. Y. App. filed June 21, 1895. A rheostat having a resistance divided into a number of steps or sections adapted to cut out of circuit successively to reduce the resistance in circuit, the last of final section in circuit being such resistance as to prevent the passage through it of a destructive current.

563,614. TELEPHONE SYSTEM; J. Piel, New York, N. Y. App. filed April 13, 1896. In a telephone system, the combination with the secondary of an induction coil, the receiver and the call bell or other signaling instrument in the main line, of a switch and wires therefrom to the main line for shunting either the secondary of the induction-coil and the receiver or the call-bell or other signaling instrument, according to the position of the switch.

563,692. TELEPHONE SIGNALING CIRCUIT; J. S. Stone, Boston, Mass App. filed March 18, 1896. The combination of a polarized call bell at a sub-station, and switch connections, a battery and a circuit-closing call key at a central station, with a main telephone circuit extending between the said stations, the two conductors of such circuit having a direct, permanently closed connection with the two poles respectively of the said battery, and a normally open connection through the said switch connections and key, each with an opposite pole thereof, whereby when the said key is operated the said battery is able to impress equal and opposite E. M. Fs. upon the circuit and to produce therein a zero of battery current.

563,695. ELECTRICAL CONNECTOR; B. L. Toquet, Westport, Conn. App. filed May 13, 1896. A rail bond consisting of a conductor with hollow split bushings to receive the ends of the conductor, said bushings having tapering threaded exteriors and rails having threaded openings to receive the bushings.

563,715. ELECTRIC HEATER; T. Grutting, St. Paul, Minn. App. filed Sept. 9, 1893. In an electric heater, in combination, the heating conductor whose conductivity increases with increase of temperature, and a controlling conductor whose conductivity decreases with increase of temperature in series therewith, and subject to its thermal influence.

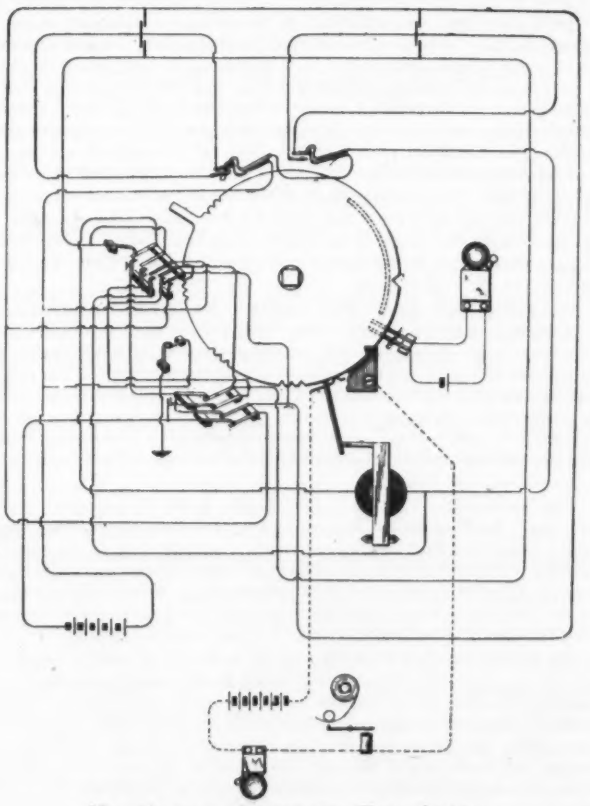
563,716. ELECTRICAL INSULATING SHEET; C. W. Jefferson, Schenectady, N. Y. App. filed March 16, 1895. An electric insulator in sheet form consisting of layers of asbestos and mica, and adhesive guttapercha tissue between any and every two of said layers.

UNITED STATES PATENTS ISSUED JULY 14, 1896.

563,724. ANNUNCIATOR SYSTEM FOR BUILDINGS; J. M. Arthur, Detroit, Mich. App. filed April 1, 1896. In an annunciator system for buildings, an electrically operated annunciator adapted to display alternately the words "Locked" and "Unlocked," or words of like significance or for like purpose, wires connecting the annunciator with means in connection with each door for opening and closing the circuit through the annunciator, said means operated by the lock of the door whereby the annunciator is so operated as to indicate the word "Locked" when the bolt of the door is forced out, and "Unlocked" when the bolt is withdrawn.

563,743. CIRCUIT CONTROLLING DEVICE; J. H. Clark, Boston, Mass. App. filed Jan. 29, 1892. In an electric controlling device, an operating shaft, an eccentric thereon, and a circular reverser operated by said eccentric, combined with a crank on the said shaft; a current regulator; a regulating member therefor; a shaft on which said member is pivoted; a pinion on said shaft, and a rack in mesh with said pinion; connected with and reciprocated by said crank.

563,749. TROLLEY WHEEL; W. C. Cottrell, Asbury Park, N. J. App. filed Aug. 28, 1895. The combination with the yoke and the axle of a trolley wheel having its ends journaled therein in ball-bearings, and having a square portion between its ends, of the inner portion of the wheel carried on the square part of said axle, the outer portion of the wheel and the balls arranged between the two.



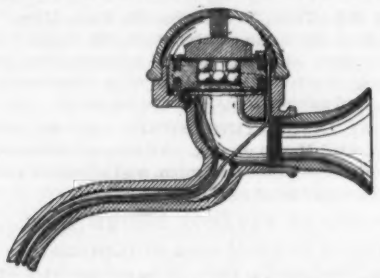
No. 563,474.—AUTOMATIC FIRE ALARM.

563,773. ELECTRIC ARC LAMP; J. C. Knight, Roselle, N. J. App. filed Nov 21, 1895. In an electric arc lamp, the combination with a movable carbon-rod and a feeding mechanism therefor, of a shunt magnet and armature for controlling said feeding mechanism; and a cut-out device for said shunt magnet comprising a metallic piece carried by said carbon-rod and a movable cut-out switch or lever, one or both parts of said cut-out device being permanently magnetized.

563,780. ELECTRIC HEATER: C. H. Minchew, Taunton, Mass. App. filed Nov. 19, 1895. In an electric heater, a rectangular metallic box provided in its ends with a series of openings, a non-conducting compound entirely filling the interior of the box, a series of flanged insulator buttons removably fitted into the openings in the ends of the box, supporting hooks hav-

ing their shanks removably and adjustably fitted in the inner ends of said buttons, and a heating wired looped at the ends of the box over a pair of said supporting hooks and provided with a series of parallel longitudinal heating coils embedded in the non-conducting packing.

563,831. THERMOSTAT: L. G. Woolley, Grand Rapids, Mich. App. filed June 24, 1895. In a thermostat, in combination with a cylindrical casing adapted to serve as one electrode, two springs serving as the other electrode, and within said casing, and fusible means for securing said electrodes to each other, and out of contact with said casing.



No. 563,935.—Telephone Transmitter.

563,832. AUTOMATIC FIRE ALARM SYSTEM; J Young, Chicago, Ill. App. filed Aug. 8, 1895. In a fire alarm system the combination with two circuits extending throughout the district to be protected, of thermostats or responsive instruments in each of said circuits, the thermostats of one of said circuits being constructed to change the electrical condition of a circuit at a lower temperature than the thermostats of the other circuit, a signal transmitting device included in each of said circuits, and means for intercepting the signal when but one of said signal-transmitting devices is operated, whereby, when both signal-transmitting devices are operated in succession the signal is transmitted to its destination, while when but one is operated the signal is intercepted.

563,877. TELEPHONE SYSTEM; W. R. Patterson, Chicago, Ill. App. filed Jan. 21, 1896. In a village or house telephone system, the combination with telephone lines extending to each of a plurality of sub-stations, each telephone line being provided at each sub-station with a switch socket, of a plug at each sub-station connected with the telephone set and adapted to be inserted into any switch socket at will, to connect the telephone set in circuit with any one of said telephone lines, a signal device and a device operated by the return of the telephone to its position of rest for actuating the signal device when the plug is not inserted in its individual socket.

563,895. ROTARY TRANSFORMER; E. Thomson, Swampscott, Mass. App. filed Dec. 21, 1893. A rotary transformer having a main armature, connected upon one side to the commutator, and receiving or delivering on the other side polyphase alternating currents, a field magnet co-operating therewith having a coil, the effect of which is substantially constant, a second or accessory armature connected in series with the main armature upon the alternating current side, and an independent field magnet co-operating with the accessory armature and delivering an excitation from the main continuous-current circuit varying in effect according to the current therein.

563,911. DYNAMO-ELECTRIC MACHINE; W. Cooper, Schenectady, N. Y. App. filed April 18, 1896. In a dynamo-electric machine, a field-magnet structure provided with laminated pole-pieces, certain of the laminæ being of less extent than the others.

563,917. INSTRUMENT FOR MEASURING ELECTRIC RESISTANCES; S. Evershed, London, England. App. filed Feb. 6, 1896. An instrument for the measuring of electric resistance, consisting of, in combination, a soft-iron horizontal needle, with soft-iron vertical tubular limb, a pin pillar supported within the vertical limb, exciting coils about the vertical limb, current coils about equal arms of the horizontal needle; a pressure coil adapted to the frame of the instrument, under and in proximity to the horizontal limb of the astatic needle, and means for the maintenance of stable balance of the needle system.

563,920 TELEPHONE SYSTEM; A. Graham, London, England. App. filed May 3, 1894. In a telephone system having two or more stations, the combination of independent receiver-circuits, a talking-receiver at each station connected permanently with its particular receiver-circuit, a talking-transmitter at each station adapted to be connected in circuit with any one of the receiver circuits of the distant stations, and a return circuit or ground connected between the transmitter and receiver at each station.

563,927. ELECTRIC LAMP STAND; W. D. Gridley, Brooklyn, N. Y. App. filed Feb. 19, 1896. An electric lamp stand comprising a sectional standard, a lamp-supporting plate interposed between successive sections of the standard, said lamp supporting plate being provided with a groove around its periphery for the reception of an electric conductor and hollow screw threaded nipples engaged with the lower wall of the said peripheral groove for the attachment thereto of ordinary electric lamps, the said standard being provided with an opening in the wall in proximity to the plate for the passage of an electric conductor to the groove at the periphery of the plate.

563,924. RAILWAY SIGNAL; C. Hansel, Easton, Pa App. filed Dec. 4, 1895. A circuit-controlling device for railway signals, comprising a spring-pressed plunger actuated by a signal blade, an adjustable collar for determining the movement of said plunger in its supports, a contact member carried by said plunger, and contacts located in an electrical circuit and making and breaking contact with the said contact member.

563,935. TELEPHONE TRANSMITTER; H. A. Martin, Hartford, Conn. App. filed Nov. 13, 1895 The combination of a chambered body; a diaphragm; a series of independently movable members in the chamber of said body and removed from direct contact with said diaphragm, and conducting fluid in said chamber, intermediate said conducting members and diaphragm, and acting as a cushioning means for said movable members and diaphragm.

563,940. DYNAMO-ELECTRIC MACHINE; A. L. Parcelle, Boston, Mass. App filed Jan. 7, 1896. The combination with an alternating-current generator, of a synchronous rotary transformer, and a two-part commutator which is connected to the secondary of said transformer.

563,960. ELECTRIC LIGHT FOR COLD-STORAGE ROOMS; D. B. and R. H. Hawes, Springfield, Mass. App. filed May 22. 1896. The combination with the door-fastening device of a cold-storage room comprising a vibratory door-fastening lever inside of said room, of an electric lamp in said room, a suitable source of electrical energy, electric conductors connecting said lamp and a source of electric energy having separate terminals near said door-fastening device, a circuit connecting and breaking device attached to the said lever for engagement between said terminals, and means outside of said room for imparting a vibratory motion to said door-fastening lever.

563,998. TROLLEY FINDER; H. H. Blanchard, Augusta, Me. App. filed Sept. 24, 1894. In a trolley finder, the combination with chains, flaring arms, sliding rods, of boxes provided with interior blocks adapted to prescribe a vertical movement of the sliding rods, and a coil-spring attached to the shaft and chains.

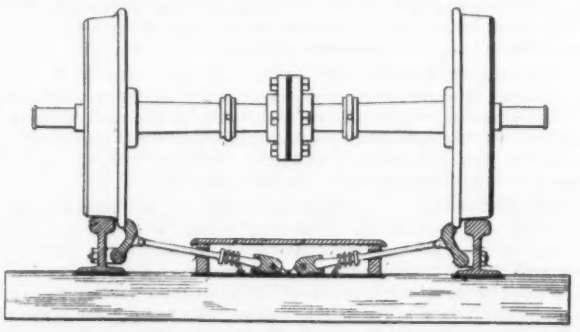
564,036. ELECTRIC HEADLIGHT FOR STREET CARS; A. C. Thompson, St. Louis, Mo. App. filed Aug. 26, 1895. In an electric headlight for street cars, a pair of tubular elbows, the same being adjustable relative to one another, the upper one of which is attached to the car-hood, a collar adjustably attached to the lower end of the lower tubular elbow, a reflector carried by said collar and an electric lamp removably attached to said collar and depending in the reflector.

564,054. ELECTRIC RAILWAY SYSTEM; D. M. de Witt, Morrillton, and W. K. Elliott, Little Rock, Ark. App, filed Jan. 29, 1896. In an electric railway system the combination with track rails, a track box, and a conductor extending through the box and provided with a contact in said box, of a contact rail pivoted at its lower edge adjacent to one track rail, and a spring pressed link having one end pivoted to the contact rail and its other end projecting into the track box and adapted to engage the said contact when the contact rail is swung upon its pivot. (See Illustration.)

564,084. PROTECTIVE APPLIANCE FOR ELECTRICAL APPARATUS; A. De Khotinsky, Boston, Mass. App. filed May 5, 1896. In a protective appliance a rod or filament of carbon forming a part of the circuit and held by a spring in tensile or longitudinal strain and means whereby the circuit is opened and grounded when the rod or filament is volatilized or disintegrated.

564,101. PRINTING TELEGRAPH; J. J. Reifgraber, St. Louis, Mo. App. filed July 30, 1895. In a synchronizer for printing telegraphy the combination of an electric cable, a fixed disc of insulating material carrying as many contact points as there are wires in the electric cable, a movable disc provided with a series of insulating concentric rings, each ring being in contact with one of the electric contact-points of the fixed disc, the said movable disc being provided in its periphery with commutator bars, each pair being connected electrically with one of the insulating rings and a rotating brush constructed to revolve in contact with the commutator bars.

564,168. SPEED AND DIRECTION INDICATOR; G. A. Tower, Richmond, Va. App. filed March 21, 1896. In a combined direction and speed indicator for rotary shafts, the combination of two electrical circuits, a suitable indicating device in each circuit, a part adapted to be shifted into one circuit by the rotation of the shaft in one direction and into the other by its rotation in the opposite direction and form a part of the circuit into which it for the time being remains, and a device for intermittently closing the circuit into which said part is shifted.



No. 564,054.—Electric Railway System.

564,173. TELEPHONE EXCHANGE APPARATUS; J. J. Carty, New York, N. Y. App. filed Nov. 17, 1887. In a telephone system, the combination with a telephone line of a normally closed connection to ground at the central station containing a battery and a calling device, a ground testing-set adapted to be connected with the line at any board, and a resistance included in circuit with said grounded testing-set so adjusted relatively to the voltage of said battery, that said calling device remains unactuated when the circuit is closed through said grounded testing-set, said resistance being also adjusted to prevent the disturbance of the operator's telephone when on metallic circuit, due to static charges passing to earth through said ground connection.

564,174. ARMORED INSULATING CONDUIT; R. T. Elwell, Hyde Park, Mass. App. filed Jan. 28, 1896. An armored insulating-conduit consisting of a metallic armor-tube, an enclosed insulating-tube capable of being bent or curved without fracture, and an interposed layer of water-resisting cementitious substance, uniting the two tubes one to the other.